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WAR MACHINE

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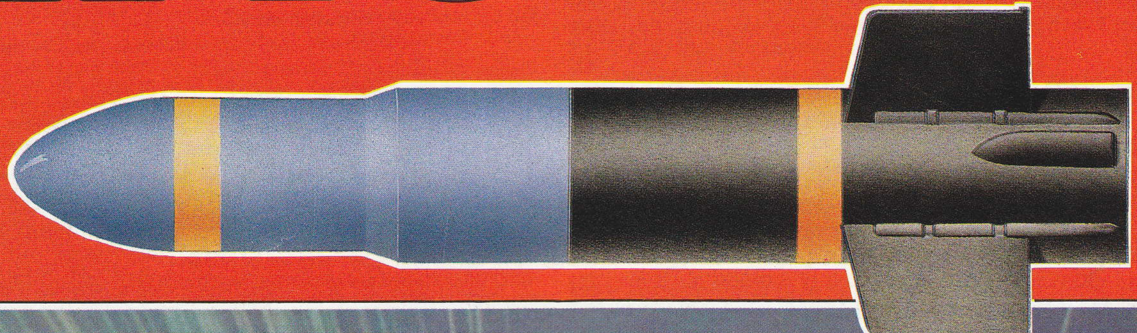

Armed Forces of the World: US Air Force (Part 5)

Anti-Tank Warheads

US Long-Range Anti-Tank Systems

TOW in Action

A fully illustrated guide to Anti-Tank Missiles

WAR MACHINE

Volume 5 **Issue 49**

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Armed Forces of the World:

US Air Force (Part 5) iii

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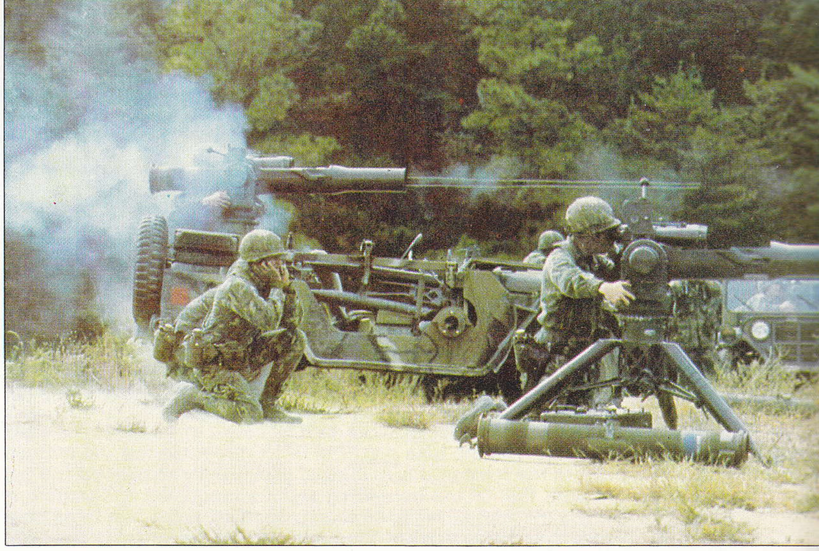
Field Artillery of World War II
Modern Transport Aircraft
Allied Tanks of World War II (Part 1)
Replenishment-at-Sea Vessels
1950s Carrierborne Aircraft

Anti-Tank Missiles

Today, as in the past, the tank remains a dominant force on the battlefield. It is being challenged, however, by a new generation of weapons which range from man-portable systems to those carried by armoured vehicles and assault helicopters.



The M151 Jeep and Bell UH-1B mounted TOW systems first saw combat in the Vietnam War during the 1972 North Vietnamese invasion of the South. The two helicopter systems deployed recorded 73 hits out of their first 89 missiles fired, destroying at least 26 tanks, including Soviet-built T-54 medium and PT-76 light amphibious vehicles.

Modern anti-tank weapons are divided into three basic categories. Heavy anti-tank weapons (HAWs) are designed to engage enemy armour well away from the defensive location, and are typified by such systems as TOW and 'Sagger'. Medium anti-tank weapons (MAWs) can engage targets out to about 1000 m (1,095 yards) from the defensive position, and are typified by the Carl Gustav and Folgore. And light anti-tank weapons (LAWs) are usually simple one-shot throw-away systems, such as the LAW80, that are used to engage close-range targets.

In terms of operational use, MAWs and LAWs have seen extensive service from World War II onwards, whilst HAWs, which are almost all anti-tank guided weapons (ATGW), have only recently come of age.

The 1973 Yom Kippur War saw the first extensive use of the ATGW, initial press reports after the war indicating that these weapons had finally vanquished the tank as the primary battlefield weapon. However, the constructive technical evaluations which followed showed that it was in fact the tank gun which scored the highest success rate, both the ATW and the LAW being classed as only moderately successful. This was in complete contrast with the relatively poor showing of the ATGW in the 1956 Sinai campaign, the 1967 Six-Day War and the 1971 Indo-Pakistan conflict. The 1972 North Vietnamese invasion of South Vietnam saw the first uses of ATGWs in South East Asia, in the forms of the AT-3 'Sagger' and then the TOW, the latter initially being used in the helicopter-borne role with startling success. Further proof of the potency of the helicopter/ATGW pairing has come since then in both the continuing Gulf War and the 1982 'Peace for Galilee' invasion of Lebanon by Israel. High confidence in such systems is demonstrated today by the high proportion of resources that both NATO and the Warsaw Pact are investing in these developments, whilst other more exotic weapons are being researched.

A British Aerospace Swingfire explodes against the thick hide of a Conqueror heavy tank. Conventional armour is no longer proof against the modern warhead, and such a strike would almost certainly disable the vehicle.

Anti-Tank Warheads

At the heart of modern anti-tank technology lies the requirement for a weapon to penetrate and incapacitate an armoured vehicle. Differing techniques are used, but the end result remains the same.

Modern anti-tank projectiles are generally fitted with one of four basic types of warhead.

The Armour-Piercing Discarding Sabot (APDS) round is designed for high-velocity weapons such as the tank gun. The APDS projectile has the armour-piercing element in the form of a hard core of significantly smaller calibre but heavier weight than that of the bore-filling sabot surrounding it. The core is shaped specifically for maximum penetration properties, and when freed from the sabot elements acquires most of the kinetic energy imparted to the complete projectile. A further recent refinement to increase armour-penetration capability is the use of depleted uranium as the core material; this reacts exothermically with the steel plate of the armour, causing it to soften slightly as the core penetrates, thus making it possible to defeat thicker armour.

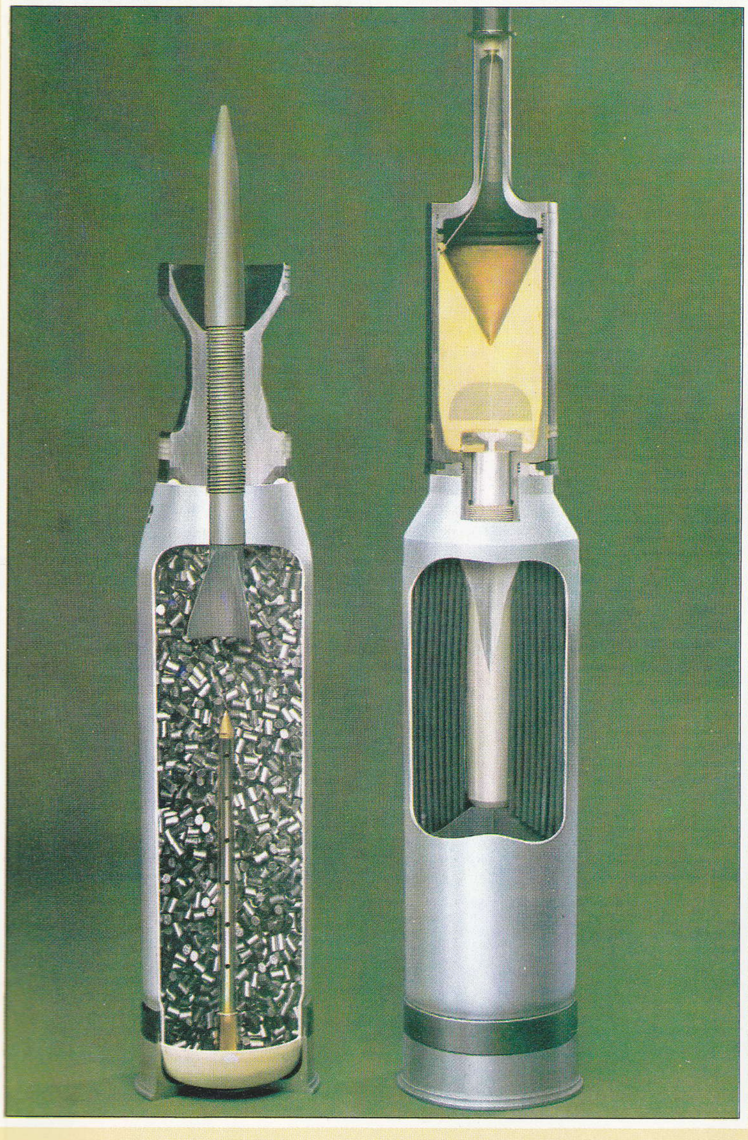
The High Explosive (HE) round with an instantaneous contact fuse can be used by artillery pieces, recoilless rifles and other MAW systems. When the projectile is sufficiently large (as in the case of the artillery rounds) it can destroy or seriously damage the external fittings of a tank such as the wheels, rollers or track to cause a mobility kill. One development, for use by higher-velocity weapons, is the High Explosive Armour-Piercing (HEAP) round, which has a hardened case to penetrate the armour and a delayed action contact fuse to detonate the explosive charge within the target to ensure a total vehicle kill.

The High Explosive Squash-Head (HESH) round is designed for both high- and low-velocity weapons. The nose of the projectile crumples upon impact to maximize the contact area before the charge is detonated. Once this happens shock waves are set up in the armour: these either incapacitate the crew directly or more likely cause metal fragments to scale off from the surface of the armour adjacent to the impact point and fly around inside the vehicle at great velocity.

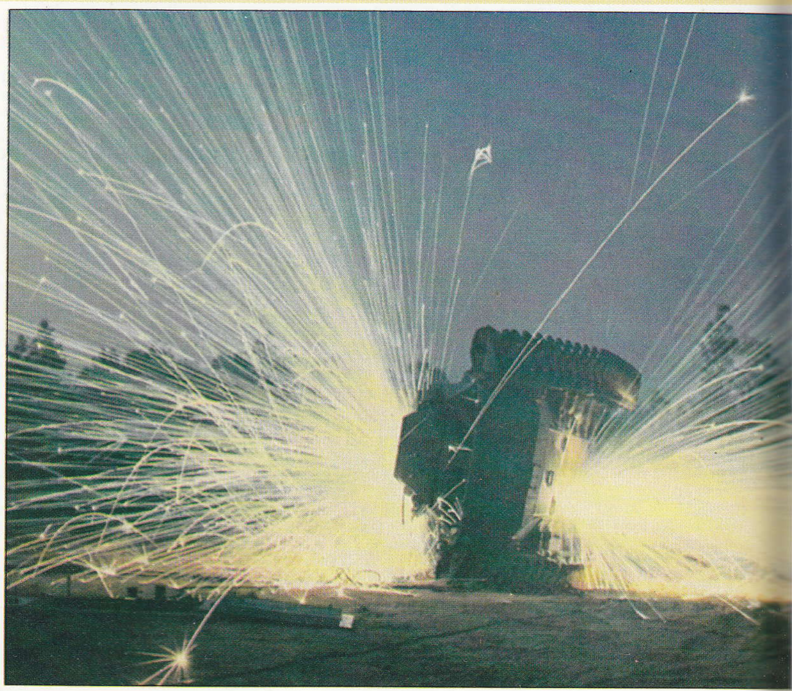
The most widely used of today's warheads is the High Energy Anti-Tank (HEAT) type. This is found in shells, rocket, grenades or missiles and needs only moderate impact velocity as it depends for its effect on the design of the warhead itself and the fuse. The latter needs to be a certain distance away from the former to start a detonation-wave running through the conical charge carried in order to concentrate the force of the explosion into a thin, fast-moving high-temperature jet that literally burns its way through the armour plate and into the vehicle's interior, where it causes catastrophic secondary explosions amongst ammunition and fuel.

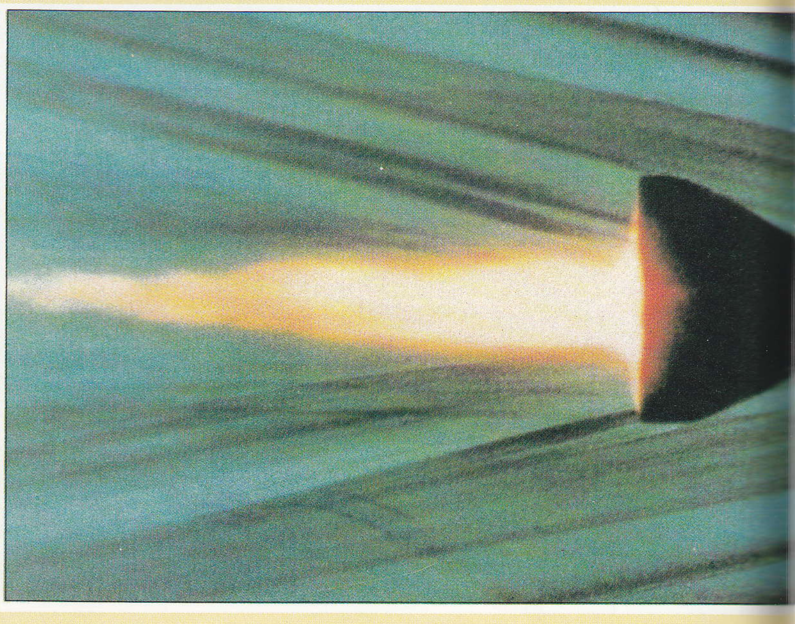
In order to defeat these warheads the armour technologists have turned to various types of 'laminate' or 'sandwich' armour, of which the British Chobham type is probably the best known. More recently the anti-tank specialists have countered this by designing weapons which attack the thinner top armour of an armoured vehicle, using self-forging fragment warheads which create their own extremely high-velocity penetrator cores that easily pierce armour plate.

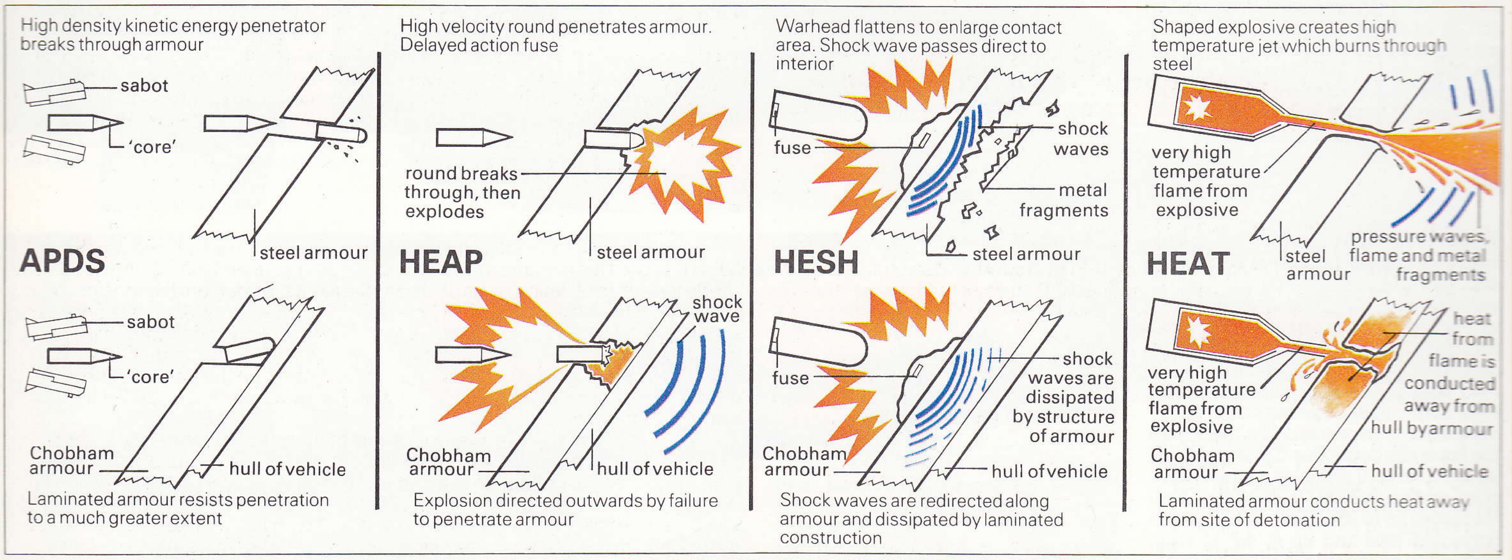
***Below:** The dart-shaped high-density penetrator of the Armour Piercing Fin Stabilized Discarding Sabot (APFSDS) round (left) is designed to utilize kinetic energy in penetrating armour. The HEAT round (right) employs a shaped explosion to blast a jet of molten metal into the interior.*

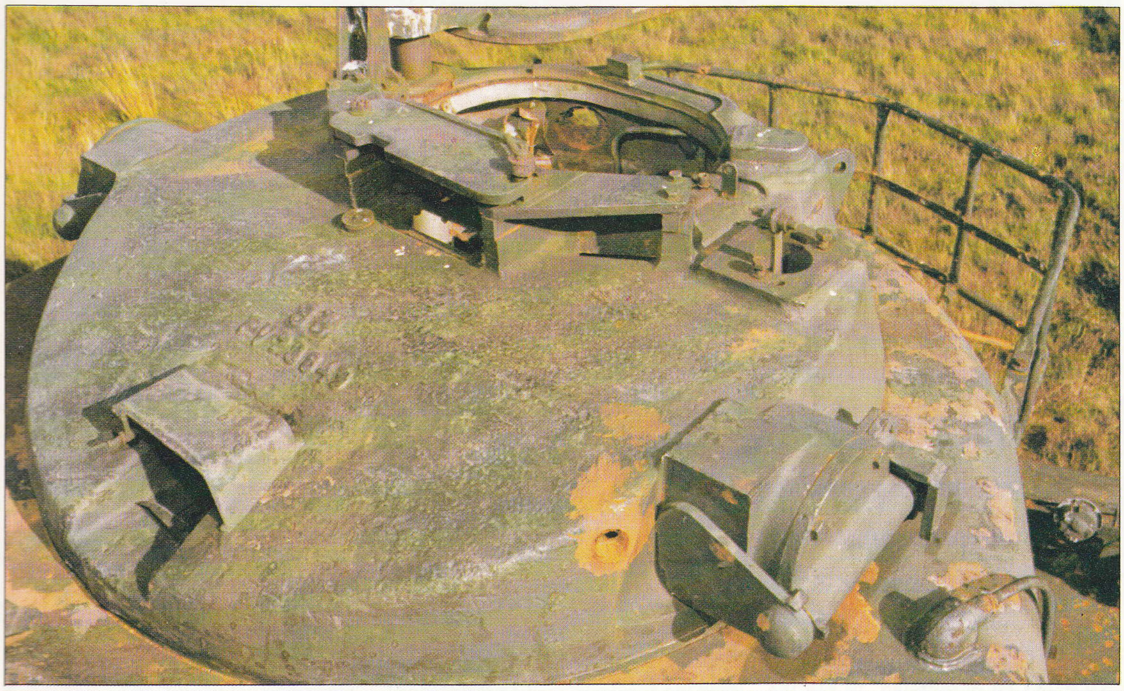


***Right:** The spectacular result of a high velocity armour-piercing round striking its target. What the picture cannot show is the awesome clang generated by a high-velocity piece of depleted uranium shearing through centimetres of metal in a fraction of a second.*

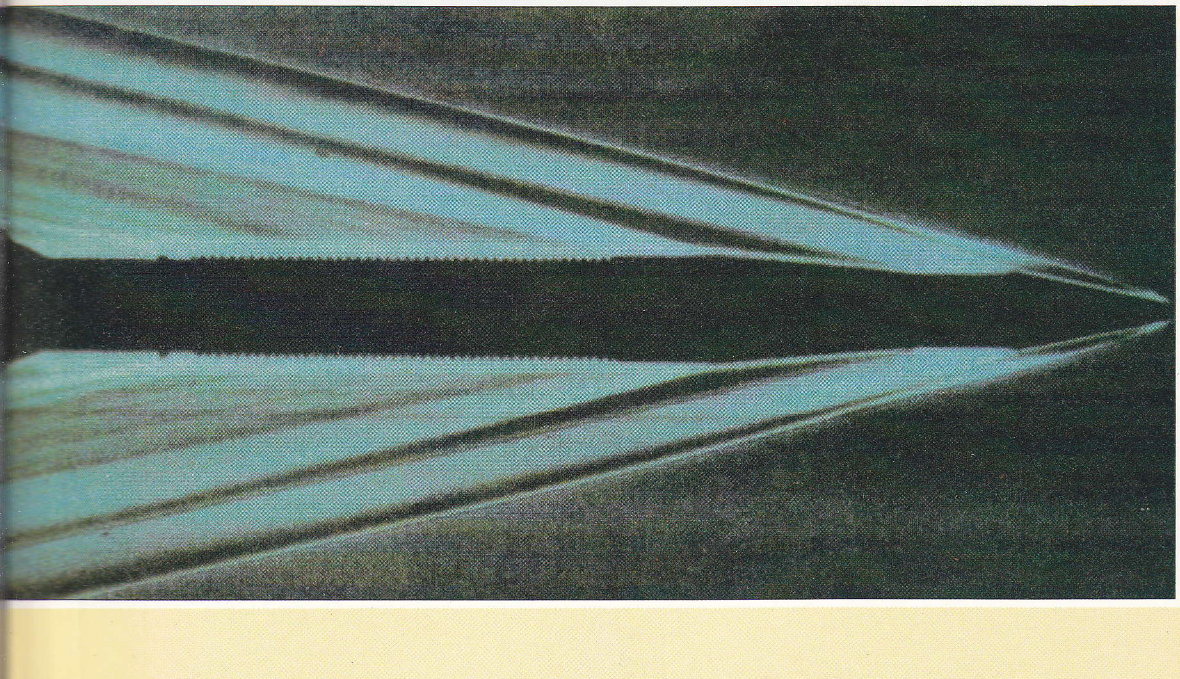





High density kinetic energy penetrator breaks through armour
sabot
'core'
steel armour
APDS
sabot
'core'
Chobham armour
hull of vehicle
Laminated armour resists penetration to a much greater extent
High velocity round penetrates armour. Delayed action fuse
round breaks through, then explodes
steel armour
HEAP
shock wave
Chobham armour
hull of vehicle
Explosion directed outwards by failure to penetrate armour
Warhead flattens to enlarge contact area. Shock wave passes direct to interior
fuse
shock waves
metal fragments
steel armour
HESH
fuse
shock waves are dissipated by structure of armour
Chobham armour
hull of vehicle
Shock waves are redirected along armour and dissipated by laminated construction
Shaped explosive creates high temperature jet which burns through steel
very high temperature flame from explosive
steel armour
pressure waves, flame and metal fragments
HEAT
very high temperature flame from explosive
heat from flame is conducted away from hull by armour
Chobham armour
hull of vehicle
Laminated armour conducts heat away from site of detonation



In a 1979 demonstration of the lethality of shaped charge warheads, two Swingfire missiles were fired against a Conqueror heavy tank hulk (above), which was the heaviest and best protected conventionally armoured tank ever built in the UK. One struck the 130-mm thick 60° front glacis plate at an angle of 40° to the main axis, with the jet penetrating the driver's compartment, the bulkhead between this and the fighting compartment, causing severe damage there and in the engine compartment beyond to destroy the tank. The other struck the commander's cupola (left) on top of the turret, with the jet burning right through it and leaving two holes in the sides. The explosion of the warhead blew off all the hatch covers and caused a scab to break away; this caused considerable damage to the interior of the turret.

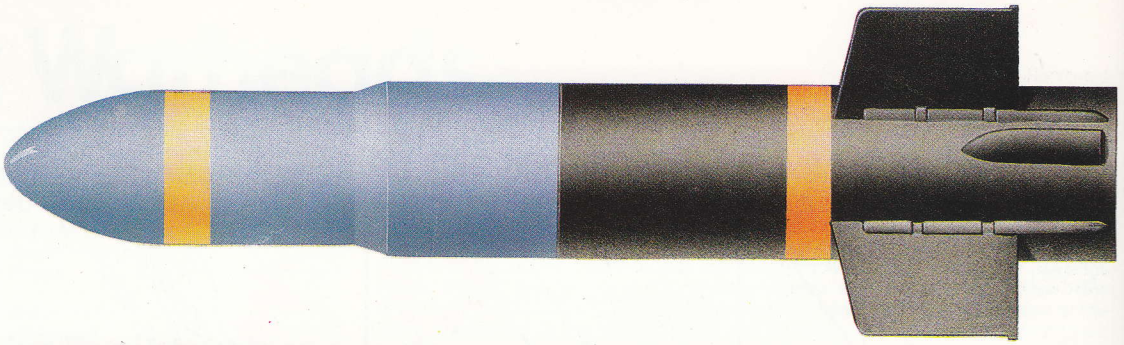


Left: Caught dramatically by high-speed flash photography, the heavy metal penetrator of an Armour Piercing Fin Stabilized Discarding Sabot (APFSDS) round races towards its target.

UK

BAe Swingfire

Swingfire is the standard long-range ATGW of the British army, and is used from tracked vehicles. In its Beeswing guise the missile is produced under licence by Egypt to replace the obsolete Soviet AT-1 'Snapper' missile.



The **BAe Swingfire** is the British army's long-range wire-guided ATGW, and was designed originally for use on vehicles operating with armoured units. Allocated to the Royal Artillery, the Swingfire is mounted on the Striker (five with five reloads) and the FV438 (two with 14 reloads) armoured vehicles. Both can engage targets in either the direct or separated-fire modes. In the latter the controller can site himself up to 100 m (110 yards) from the launch point and up to 23 m (75 ft) higher, with the target up to 20° above or below the horizontal axis and up to 45° to each side of the concealed launcher's bearing. The Swingfire has now been adapted to fit on almost any vehicle and, in the **Beeswing** version, can be used from a removable crew-served launcher assembly. Once fired the missile is automatically gathered into the control sight's field of view, after which the operator flies the missile to the target by a joystick control. The warhead is able to defeat the armour of all known battle tanks. To improve the missile's combat capabilities a thermal-imaging sight has been developed for night engagements, and micro-miniaturized electronics have been introduced to increase reliability and maintainability. The Beeswing is currently being licence-built in Egypt, which is also supplying Sudan with the system. Current operators of the Swingfire system are Belgium, Egypt, Kenya, Sudan and the UK.

A British Army FV438 fires a Swingfire ATGW from its roof-mounted missile launcher rack assembly. The 4000-m (4,375-yard) range missile has a 7-kg (15.4-lb) hollow charge warhead capable of defeating the armour of all current main battle tanks.

Specification

Swingfire
Type: anti-tank missile
Dimensions: length 1.07 m (3 ft 6 in); diameter 17.0 cm (6.7in); span 37.3 cm (1 ft 2.7 in)
Launch weight: 27 kg (60 lb)
Propulsion: two-stage solid-propellant booster/sustainer rocket
Performance: range 150-4000 m (165-4,375 yards)
Warhead: 7-kg (15.4-lb) hollow-charge HE
Armour penetration: 800 mm (31.5 in) or more

UK

Hunting LAW80

The one-shot disposable **Hunting LAW80** weapon is under development by Hunting Engineering Ltd to replace the British army's Carl Gustav MAW and M72 LAW systems. The LAW80 will be capable of disabling all the armoured vehicle types likely to be encountered on the battlefield in the next decade or so, from all angles of attack (including head on through the frontal armour plate). This requirement makes the weapon more expensive in terms of size, weight and cost than contemporary LAW systems. The launcher will be issued as a round of ammunition, and will be equipped with an integral 9-mm 5-round spotting rifle attachment to ensure a very high first-round hit probability. To fire the 4-kg (8.8-lb) round the launcher's two protective end caps are discarded, the projectile tube extended to its fullest extent, and the weapon armed and cocked. The firer then uses the spotting rifle and, if he decides not to shoot, can close the blast shield to make the weapon safe until the next action. The LAW80 will also be issued to the Royal Marines and the RAF Regiment. But though designed to replace the Carl Gustav, the LAW80 will not be able to give the same service as it is unable to function as an infantry support weapon in firing HE, smoke and illuminating rounds. In this respect the army might well be advised to reconsider its options and retain the Carl Gustav at higher unit levels.

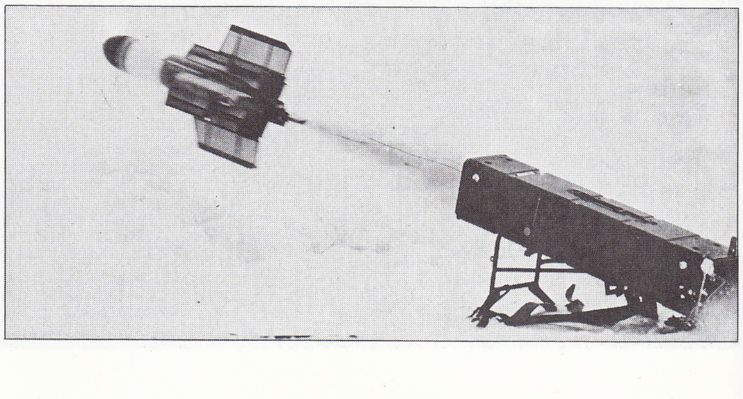
Specification

LAW80
Type: anti-tank rocket-launcher
Dimensions: length 1.0 m (3 ft 3.4 in) folded and 1.5 m (4 ft 11.1 in) extended; calibre 9.4 cm (3.7 in)
Weight: 9.5 kg (20.9 lb)
Performance: range 500 m (545 yards)
Ammunition: advanced-design 4-kg (8.8-lb) hollow-charge rocket
Armour penetration: estimated at 600 mm (23.62 in) or more

SWEDEN

Bofors Bantam

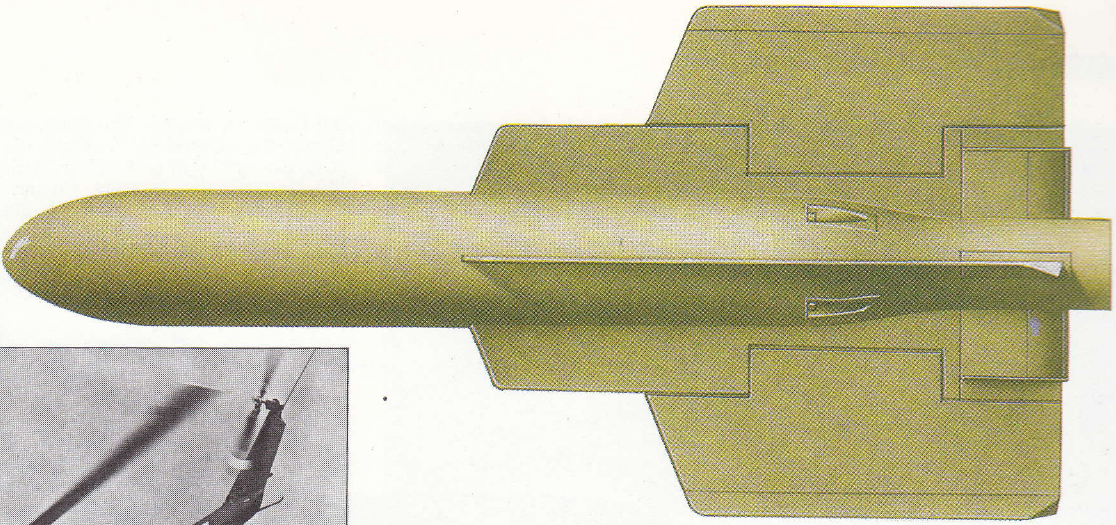
The **Bofors Bantam** is a small first-generation one-man portable manual command to line of sight wire-guided missile produced by AB Bofors. The missile container holds both the missile and a 20-m (66-ft) control cable which connects the missile to the control unit, which can take up to three missiles. Distribution boxes can be connected to each of the cables to boost this number to 18. To bring the Bantam into action the container is placed on the ground and the control unit is connected (if necessary extra cable can be used to displace the operator by up to 120 m/130 yards from the missile site). The operator then selects from between one and four of the tracking flares carried on the missile (according to the prevailing conditions of visibility) and launches the



The ground-launched version of the AB Bofors Bantam ATGW emerges from its container-launcher box under power from the booster. After 40 m (44 yards) of wire is reeled out, a micro-switch ignites the sustainer motor.

Bofors Bantam (continued)

Right: The Swedish Bantam was one of the first generation wire-guided ATGWs, and was produced in large numbers until 1978 for the armies of Sweden and Switzerland. It is one of the smallest and lightest of the ATGWs and introduced into service the GRP airframe with folding wings.



The Bantam can also be used from fixed-wing light aircraft, or helicopters such as the Swedish army Agusta-Bell AB.204 Huey seen here. The Swedes are already supplementing this old missile with quantities of the modern American TOW.

Bantam. The sustainer and flare are ignited after 40 m (130 ft) of guidance wire have been reeled out and the booster section has burnt out. The warhead is armed after 230 m (250 yards) and the operator manually guides the missile to the target. Only two countries, Sweden and Switzerland, adopted the Bantam, in 1963 and 1967 respectively, in a variety of launching modes including one from light fixed-wing aircraft. Production finished in the 1970s, and although the missile is considered to be obsolete it is still found in some numbers with those countries.

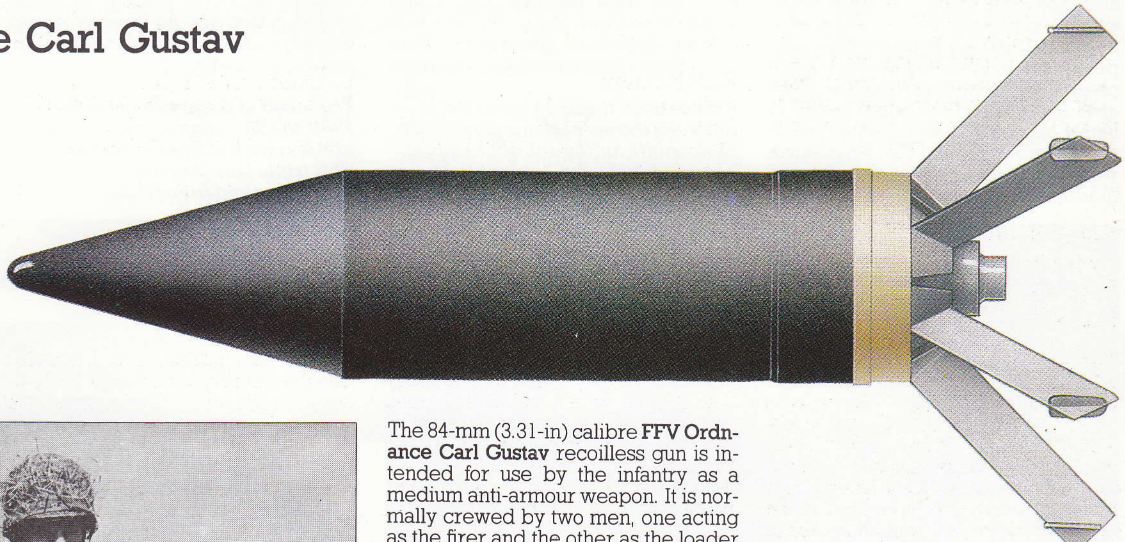
Specification

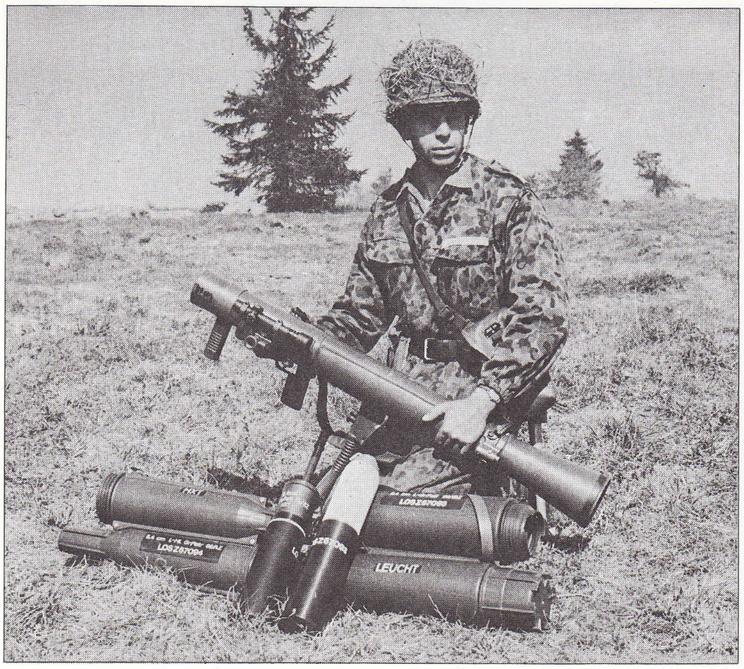
Bantam
Type: anti-tank missile
Dimensions: length 0.85 m (2 ft 9.46 in); diameter 11.0 cm (4.33 in); span 40.0 cm (15.75 in)
Launch weight: including the container 11.5 kg (25.35 lb)
Propulsion: two-stage solid-propellant booster/sustainer rocket
Performance: range 300-2000 m (330-2,190 yards)
Warhead: 1.9-kg (4.2-lb) hollow-charge HE
Armour penetration: 500 mm (19.68 in) or more

SWEDEN

FFV Ordnance Carl Gustav

Right: The Carl Gustav is normally fired by a two-man crew, one acting as the gunner and the other as the loader. A well-trained team can fire about six rounds per minute at moving or stationary armoured vehicles out to 400-500 m (437-547 yards) distance.





The 84-mm (3.31-in) calibre M2 Carl Gustav is seen here with the HEAT and HE rounds that it fires, together with the canisters in which they are carried.

The 84-mm (3.31-in) calibre **FFV Ordnance Carl Gustav** recoilless gun is intended for use by the infantry as a medium anti-armour weapon. It is normally crewed by two men, one acting as the firer and the other as the loader and ammunition carrier. A well-trained crew can sustain a rate of fire of six rounds per minute. The weapon is breech-loaded and can be fired from the shoulder, from the prone position, from the edge of a trench or from a mount on an APC. The usual sighting system on the **Carl Gustav M2** model is a ×2 telescope with a 17° field of view. The M2 can effectively engage a stationary armoured vehicle at 500-m (545-yard) range with the FFV551 HEAT round, and a moving target at ranges up to 400 m (435 yards) with a penetration of 400 mm (15.75 in). It is also a useful infantry support weapon in that it can fire the 3.1-kg (6.8-lb) spin-stabilized FFV545 illuminating round to 2300 m (2,515 yards), the 3.1-kg (6.8-lb) FFV469 smoke round to 1300 m (1,420 yards) and the 3.1-kg (6.8-lb) FFV441 HE shrapnel round to an effective range of 1000 m (1,095 yards).

An improved version with a better sight, the **Carl Gustav M2-550**, has also been produced to fill the gap between close-range weapons and the ATGW. This uses a higher-velocity rocket-assisted HEAT round, the FFV551, which has a maximum effective engagement range of 700 m (765 yards) with the same armour-penetration capability as the FFV551 round, and can also fire the rounds mentioned above. A new 3.2-kg (7.1-lb) dual-purpose HE/HEAT FFV502 projectile is also under development for the Carl Gustav series, this being designed for use against light armoured vehicles (out to 250 m/275 yards with 200-mm/7.87 in armour penetration or more) as well as unprotected targets to 1000 m

FFV Ordnance Carl Gustav (continued)

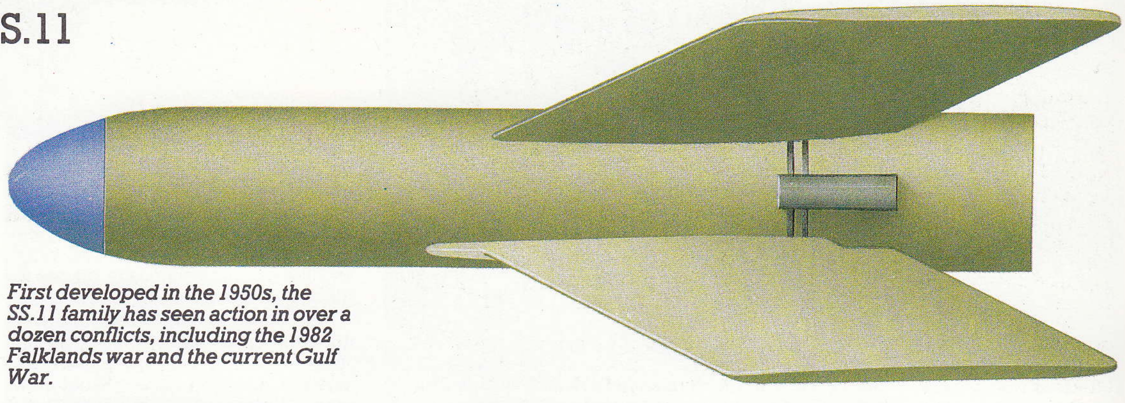
(1,095 yards). In order to defeat the new composite-armour tanks, production is about to start of the FFV597 two-piece over-calibre rocket-assisted fin-stabilized HEAT round with a stand-off probe fuse to give optimum penetration effect. The FFV597 consists of a 4-kg (8.8-lb) warhead section, which is inserted into the muzzle of the gun, and a 3-kg (6.6-lb) propulsion cartridge which is loaded as normal. The 5.8-kg (12.8-lb) projectile has a range in excess of 300 m (330 yards) and can penetrate over 900 mm (35.43 in) of frontal armour.

A lightweight version of the standard weapon, the **Carl Gustav M3**, entered production in 1984 and is able to fire all the existing types of ammunition. The Carl Gustav has seen extensive combat use throughout the world, including use with the British forces on the Falklands in 1982. The basic Carl Gustav M2 is used by Australia, Austria, Canada, Denmark, Eire, Ghana, the Netherlands, Norway, Sweden, the United Arab Emirates, UK, East Germany and several other countries; the Carl Gustav M2-550 is operated by Japan, Sweden and other countries; and the Carl Gustav M3 is used only by Sweden.

Specification
Carl Gustav
Type: anti-tank rocket-launcher
Dimensions: length 1.13 m (3 ft 8.5 in); calibre 8.4 cm (3.31 in)
Weight: M2 14.2 kg (31.3 lb), M2-550 15 kg (33.1 lb) and M3 8 kg (17.6 lb)
Performance: range see text
Ammunition: see text
Armour penetration: see text

FRANCE

Aérospatiale SS.11



First developed in the 1950s, the SS.11 family has seen action in over a dozen conflicts, including the 1982 Falklands war and the current Gulf War.

Originally developed by Nord-Aviation, the **Aérospatiale SS.11** started life in 1953 as the **Type 5210** and entered service with the French army in 1956. Apart from its normal ground- or vehicle-launched role, it can also be launched from a helicopter or ship. It is a manually-guided line-of-sight weapon, the operator acquiring the target by means of a telescopic sight. As soon as the missile enters his field of view after launch the operator commands it to his line of sight via a joystick control and wires, and then flies it to the target using tracking flares mounted on the rear of the missile for visual reference. From 1962 a modified **SS.11B1** variant was produced with transistorized firing equipment. This weapon can be fitted with a variety of warheads including the Type 140AC anti-tank, the Type 140AP02 semi-armour-piercing delay-action anti-personnel, and the Type 140AP59 anti-personnel fragmentation. Production ceased at the beginning of the 1980s after some 179,000 rounds of the SS.11 family had been built for more than 20 countries. A modified SS.11 derivative with a much improved semi-automatic guidance system, the **Harpon**, was produced in some numbers for the French, West German and Saudi Arabian armies from 1967 onwards. The missile family has seen action in numerous conflicts over the years and was used most recently from British army Westland Scout helicopters against Argentine ground positions during the recapture of the Falklands in 1982. It is also seeing regular use in the Gulf War with both the Iraqis and the Iranians. Current operators of the SS.11 are Argentina, France, India, Iran, Iraq, Italy, Tunisia, Turkey, UK, Venezuela and a number of undisclosed customers. As far as is known, the only current possessor of the Harpon type is India.

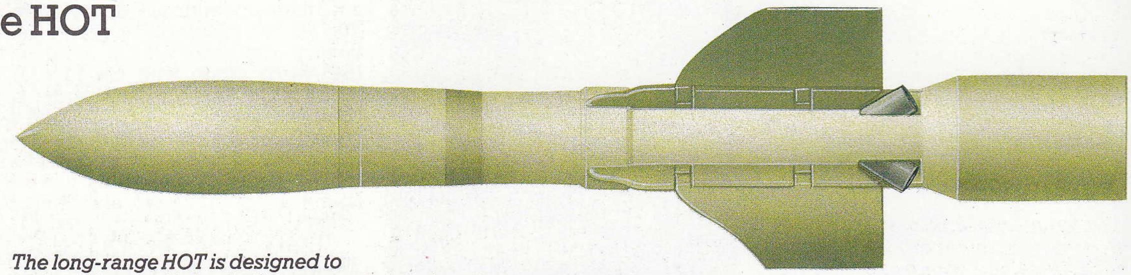
Specification
SS.11B1
Type: anti-tank missile
Dimensions: length 1.20 m (3 ft 11.25 in); diameter 16.40 cm (6.46 in); span 50.00 cm (1 ft 7.7 in)
Launch weight: 29.9 kg (65.9 lb)
Propulsion: two-stage solid-propellant rocket
Performance: range 500-3000 m (545-3,280 yards)
Warhead: see text
Armour penetration: Type 140AC 600 mm (23.62 in) and Type 140AP02 10 mm (0.4 in)

France used the SS.11 when it was amongst the earliest missiles to arm helicopters for the anti-tank role, as exemplified by the Aérospatiale Alouette III in action here.

Produced in large numbers since 1956, the SS.11 has served in many armies on a wide variety of vehicles. This triple launcher was photographed in Portugal.

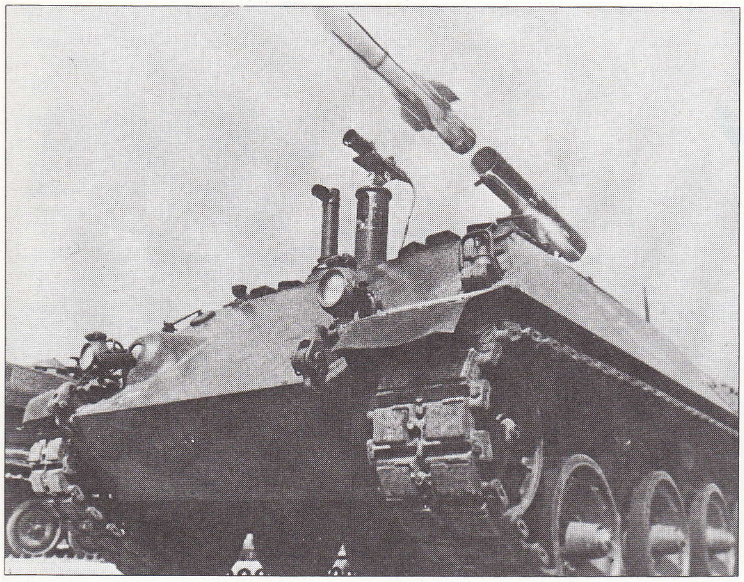
FRANCE/WEST GERMANY

Euromissile HOT



The long-range HOT is designed to be fired from vehicles, helicopters and fixed static positions against tanks, infantry combat vehicles and APC targets. To ensure its lethality against the new generation of Soviet laminate armour, an improved hollow-charge warhead is under development.

The **Euromissile HOT** is the heavyweight spin-stabilized tube-launched wire-guided counterpart to the MILAN for use from dug-out positions, vehicles and helicopters. Planned as the direct replacement for the SS.11, the HOT has automatic command to line of sight guidance with an IR tracking system. All the operator has to do is to keep his optical tracking sight on the target to ensure a hit. This guidance system allows a very rapid gathering of the missile to the line of sight after launch, thus enabling a very



A West German army Jagdpanzer Jaguar 1 tank destroyer fires a Euromissile HOT ATGW. The 316 Jaguars were rebuilt from Jagdpanzer Rakete vehicles equipped with two launchers for the less capable SS.11 ATGW during the period 1978-83.

The Panhard 4×4 VCR APC, armed with the Euromissile Mephisto launcher system for the HOT long range ATGW. The UTM800 HOT turret variant of the 6×6 Panhard VCR/TT has already seen combat with the Iraqi army during the Gulf War.

good short-range engagement envelope. Vehicles which have been fitted with the system include the M113 APC (two launchers with 11 reloads), the AMX10P APC (four launchers with 16-20 reloads), the Panhard M3 APC (four launcher with 14 reloads), the Saviem VAB armoured vehicle (four launchers with eight reloads) and the Raketenjagdpanzer tank destroyer 3 (one launcher with 8 reloads). The helicopter types that have been fitted include the MBB PAH1 (six rounds), the Aérospatiale SA 341 and SA 342L Gazelle (four or six rounds), the Aérospatiale SA 361H Dauphin (eight rounds) and the Westland Lynx (eight rounds). The large hollow-charge warhead is detonated by distortion of the nose skin to allow incidence attacks of up to 65°. The warhead is said to be capable of penetrating the armour of all known battle tanks in frontal attacks. The Syrians used HOT against the Israelis in the 1982 'Peace for Galilee' war from Gazelle helicopters on up to 100 occasions, and credit the system with destroying a sizable number of Israeli tanks and APCs. The Iraqis also use it against the Iranians in the Gulf War from both vehicle and helicopter platforms. Euromissile, the manufacturer, states that as at early 1984 14 countries have ordered 52,907 missiles. Current operators of the HOT missile are Egypt, France, Iraq, Kuwait, Libya, Saudi Arabia, Spain, Syria, West Germany and five undisclosed countries.

Specification

HOT

Type: anti-tank missile

Dimensions: length 1.275 m (4 ft 2.2 in); diameter 16.5 cm (6.5 in); span 31.2 cm (12.28 in)

Launch weight: missile 23.5 kg (51.8 lb) and missile in launch tube 32 kg (70.55 lb)

Propulsion: solid-propellant booster/sustainer rocket

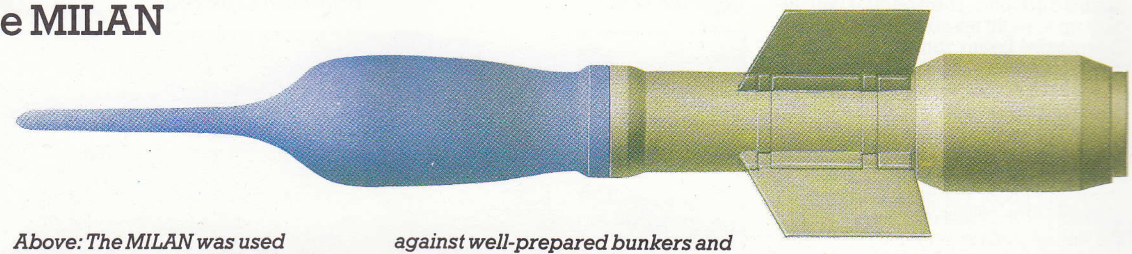
Performance: range 75-4250 m (82-4,650 yards)

Warhead: 6-kg (13.2-lb) hollow-charge HE

Armour penetration: 800 mm (31.5 in) or more

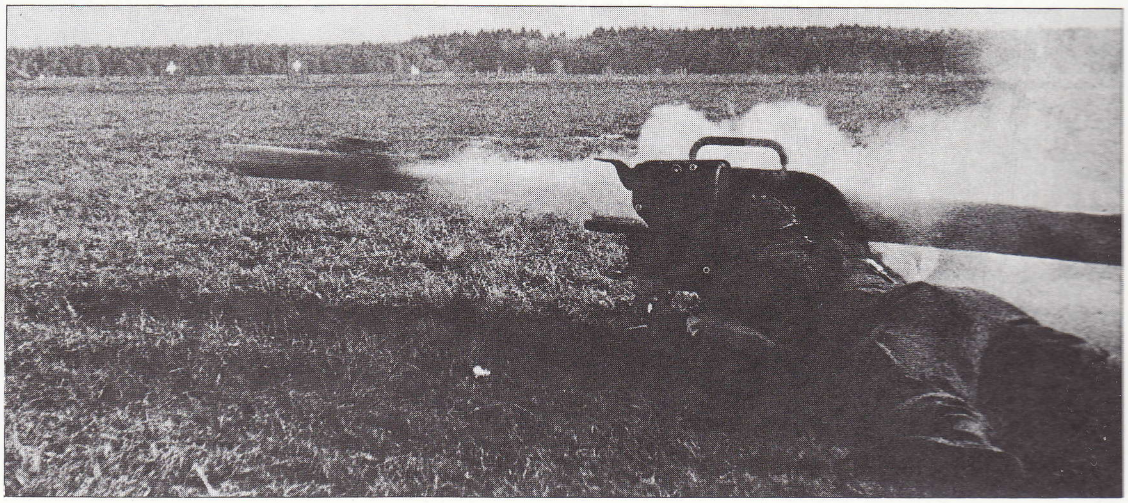
FRANCE/WEST GERMANY

Euromissile MILAN



Above: The MILAN was used extensively in the 1982 Falklands war by the British army and Royal Marines, who fired several hundred against well-prepared bunkers and emplacements in the hills and mountains barring the way to Port Stanley.

The **Euromissile MILAN** is an advanced wire-guided second-generation man-portable spin-stabilized ATGW, and started life in 1962 as a design study between Nord-Aviation and Messerschmitt-Bölkow. It incorporates a semi-automatic guidance technique that requires the operator only to maintain the cross hairs of his guidance unit sight on the target during the engagement. The system comprises a launch-and-control unit and a missile in a container-launcher tube, which is mounted on the launcher/controller just before firing. The whole system can then be mounted on a tripod for ground launch or on a pivot for vehicle launch. Since it attained operational status the MILAN has had a night-firing capability developed for it in the form of the MIRA thermal imaging device for the French, West German and British armies. This consists of a 7-kg (15.4-lb) imaging sight which is mounted on the firing post to allow the detection of targets at over 3000 m (3,280 yards)

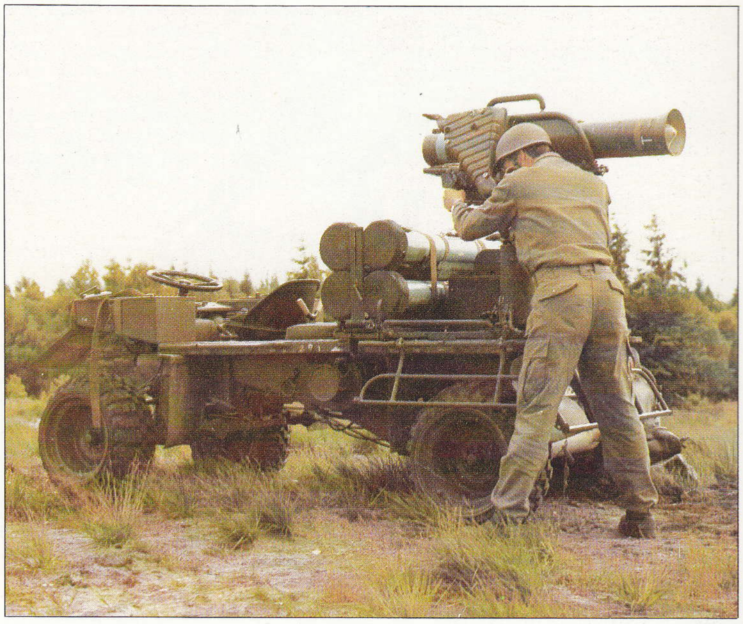


The MILAN has already seen combat service in a number of conflicts including Chad, where one was used to knock out a Panhard ERC armoured car that had been captured by the Libyan-backed rebels.

and their engagement at about 1500 m (1,640 yards). Once the missile has been launched, the forces inherent in the system throw the used container-launcher (which has been automatically disconnected) backwards from the firing post for reloading. The missile is automatically tracked in flight by an IR unit in the control unit, which monitors the radiation output from the tail-mounted flares on the missile. A programme is currently under way to improve the warhead's effectiveness by at least 25 per cent at close range against the new types of laminated armour protecting Soviet tanks. By early 1984 30 countries had bought a total of 164,576 missiles. Although a relatively new system, the MILAN has seen combat in Chad against the Libyans, in the Gulf war and in the Falklands with the UK against Argentina. In the last conflict it gained a reputation as a capable but somewhat expensive 'bunker basher'. The MILAN is used by Algeria, Belgium, Cameroun, Chad, Chile, Egypt, Eire, France, Greece, India, Iraq, Israel, Iran, Kenya, Lebanon, Libya, Morocco, Senegambia, Somalia, Spain, Syria, Tunisia, UK, West Germany and five other countries.

Specification

Type: anti-tank missile
Dimensions: length 0.769 m (2 ft 6.28 in); diameter 9.0 cm (3.54 in); span 26.5 cm (10.43 in)
Launch weight: missile 6.65 kg (14.66 lb) and complete launcher outfit (with control unit, launcher tube and tripod) 16.5 kg (36.38 lb)
Propulsion: solid-propellant booster/sustainer rocket
Performance: range 25-2000 m (27-2,190 yards)
Warhead: 2.98-kg (6.57-lb) hollow-charge HE
Armour penetration: 650 mm (25.6 in) or more



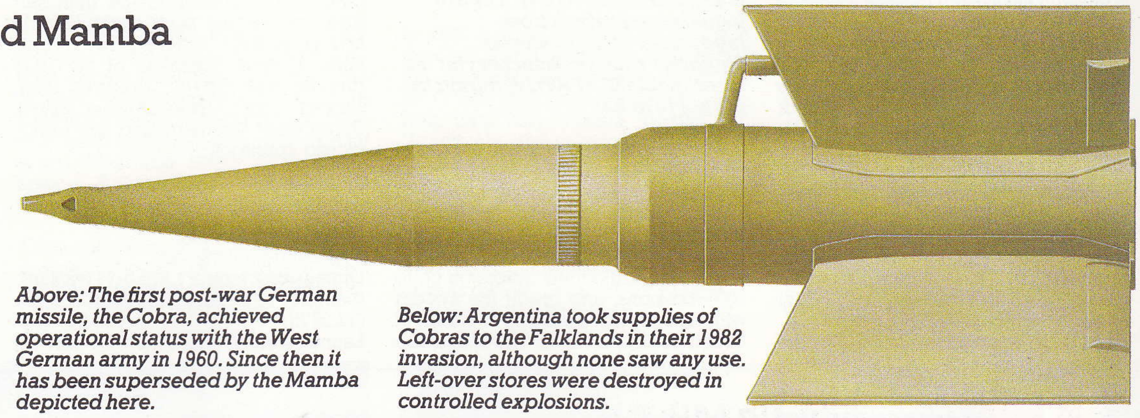
The man-portable Euromissile MILAN, mounted on the rear of a West German army Faun Kraka 4×2 light vehicle. The MILAN-equipped Kraka with six reload missiles has replaced the 106-mm recoilless rifle vehicles of the same type.

WEST GERMANY

MBB Cobra and Mamba

The **MBB Cobra** started life in 1957 as a project by Bölkow GmbH, and went into service three years later in an initial 1600-m (1,750-yard) range form with the West German army. Since then some 170,000 or more rounds have been produced in both this form and the 2000-m (2,185-yard) range definitive **BO810 Cobra 2000** version for the armed forces of 18 countries. A first-generation ATGW, the Cobra is a one man line-of-sight wire-guided missile that is set up by being placed on the ground in a suitable space, with its nose preferably pointing in the required direction. The operator can deploy up to eight missiles in this fashion, the missiles being connected via 20-m (66-ft) cables to a junction box and thus to his control unit, which may itself be deployed up to a further 50 m (165 ft) away. The operator uses the controller to select and fire the round that is in the best position to engage the target. Once launched, the missile is given a vertical boost to rise into the air, where the limited-duration sustainer takes over. The operator then rapidly gathers the missile into his line of sight and flies the missile to the target with the aid of a joystick and tail-mounted flares.

In 1972 MBB announced a successor to the Cobra 2000 known as the **Mamba**. Of the same general appearance, this weapon system has a new and improved controller that can be attached to up to 12 missiles, and a new propulsion unit which allows jet lift throughout the flight at a higher maximum speed to give a shorter flight time. The Mamba is still in production and has replaced the Cobra in a number of armies with the added bonus that it can be fired from a five-round missile-launch frame mounted on a vehicle. The Cobra was used in combat during the Indo-Pakistan War of 1971 and by Israel against the Arabs in 1973. Current operators of the Cobra include Argentina, Brazil (licence-built), Denmark, Greece, Israel, Italy (licence-built), Pakistan (licence-built), Spain, Turkey (licence-built), West Germany



Above: The first post-war German missile, the Cobra, achieved operational status with the West German army in 1960. Since then it has been superseded by the Mamba depicted here.

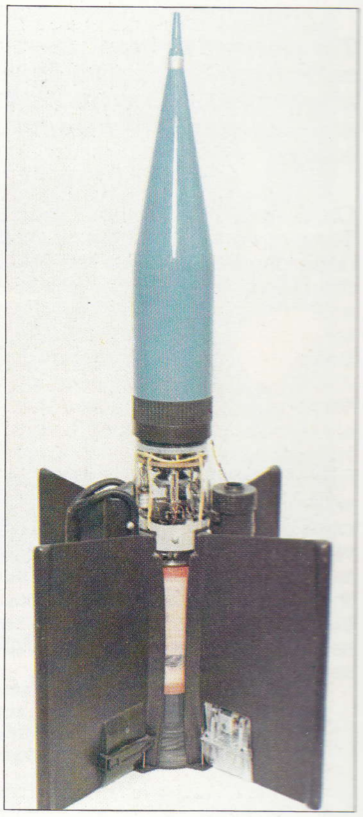
Below: Argentina took supplies of Cobras to the Falklands in their 1982 invasion, although none saw any use. Left-over stores were destroyed in controlled explosions.

(in store) and eight undisclosed countries. The Mamba is used by Chile and an unknown number of other countries.

Specification
Cobra
Type: anti-tank missile
Dimensions: length 0.95 m (3 ft 1.4 in); diameter 10.0 cm (3.93 in); span 48.0 cm (1 ft 6.6 in)
Launch weight: 10.3 kg (22.7 lb)
Propulsion: solid-propellant booster/sustainer rocket
Performance: range 400-2000 m (435-2,190 yards)
Warhead: 2.7-kg (5.95-lb) hollow-charge HE or anti-tank shrapnel
Armour penetration: hollow charge 500 mm (19.69 in) and shrapnel 350 mm (13.78 in)

Specification
Mamba
Type: anti-tank missile
Dimensions: length 0.955 m (3 ft 1.6 in); diameter 12.0 cm (4.72 in); span 40.0 cm (1 ft 3.75 in)
Launch weight: 11.2 kg (24.7 lb)
Propulsion: solid-propellant booster/sustainer rocket
Performance: range 300-2000 m (330-2,190 yards)
Warhead: 2.7-kg (5.95-lb) hollow-charge HE
Armour penetration: 500 m (19.69 in)

The Cobra ATGW was used in combat during the 1965 Indo-Pakistan war, with limited results. Despite this the missile is used by a number of armies in conjunction with other systems as a very useful man-portable unit.

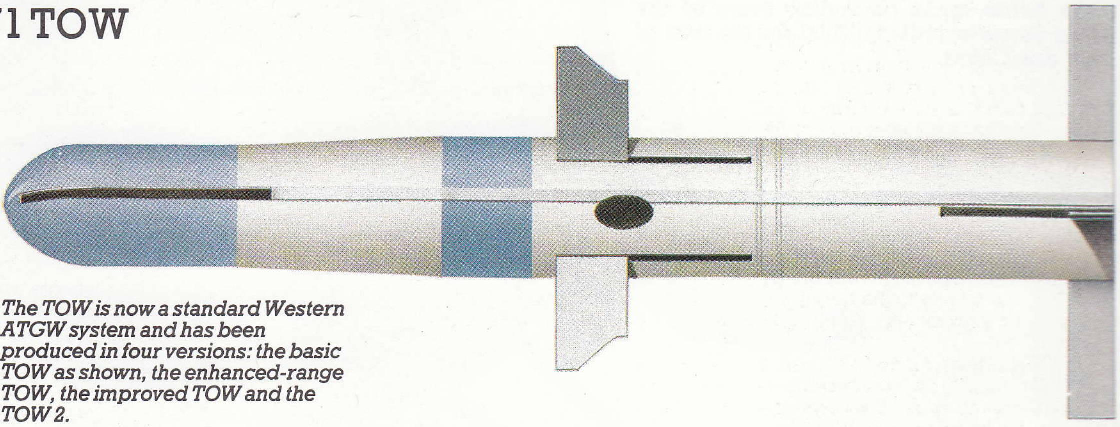


Above: A Cobra sectioned to show the major internal subsystems. The booster rocket used to launch the missile can be seen between the lower pair of wings, its nozzle deflected downwards to give the sudden initial jump into the air on firing.

USA

Hughes BGM-71 TOW

The **Hughes BGM-71 TOW** (Tube-launched Optically-tracked Wire-guided) heavy anti-tank missile for helicopter- or vehicle-launch application entered the design phase in 1962, the first guided firings taking place in 1968. Two years later TOW entered service, and by the summer of 1972 had seen its first combat firings when it was used against North Vietnamese tank units. During the 1973 Yom Kippur War the Israelis had it delivered as part of the arms lift by the USA, and by 1984 the missile had been used in many conflicts all over the world. On the strength of its operational success the TOW has become the West's most numerous ATGW with over 350,000 units so far produced for more than 25 countries. As in most contemporary systems, all the operator has to do is keep the cross hairs of his optical sight on the target, an IR sensor tracking the signal from the missile to permit the calculation of correction commands which are automatically sent via the guidance wire link. In order to improve the lethality of the warhead of infantry units' TOW missiles, a two-stage upgrade programme was adopted: the first phase was marked by the procurement of a warhead of 127-mm (5-in) diameter fitted with a telescopic nose probe fuse that pops out when the missile is in flight to give an optimum stand-off penetration capability, the missile fitted with this warhead being known as the **Improved TOW**; the second stage saw the introduction of the **TOW 2** missile, which has a 152-mm (6-in) diameter warhead fitted with telescopic nose probe, improved digital guidance and a new propulsion system. All these improvements are also being retrofitted to the helicopter and armoured vehicle TOW launcher systems. The TOW version sometimes described as the **Extended-Range TOW** is the basic TOW variant that entered production from 1976 onwards with increased range capablities. The TOW missile is very widely used, typical operators being Bahrain, Canada, Denmark, Egypt, Finland, Greece, Iran, Israel, Italy, Japan, Jordan, Kenya, Kuwait, Lebanon, Luxembourg, Morocco, the Netherlands, North Yemen, Norway, Oman, Pakistan, Portugal, Saudi Arabia, South Korea, Taiwan, Thailand, Turkey, United Arab Emirates, UK, USA and West Germany.



The TOW is now a standard Western ATGW system and has been produced in four versions: the basic TOW as shown, the enhanced-range TOW, the improved TOW and the TOW 2.

Specification
TOW
Type: anti-tank missile
Dimensions: length 1.174 m (3 ft 10.2 in) for basic model, 1.555 m (5 ft 1.2 in) for Improved TOW with probe, and 1.714 m (5 ft 7.5 in) for TOW 2 with probe; diameter 15.2 cm (6 in); span 34.3 cm (13.5 in)
Launch weight: 22.5 kg (49.6 lb) for basic model, 25.7 kg (56.65 lb) for Improved TOW, and 28.1 kg (61.95 lb) for TOW 2
Propulsion: two-stage solid-propellant rocket
Performance: range 65-3000 m (70-3,280 yards) for pre-1976 models, and 65-3750 m (70-4,100 yards) for post-1976 models
Warhead: 3.9-kg (8.6-lb) shaped-charge HE for basic and Improved TOW models, and 5.9-kg (13-lb) shaped-charge HE for TOW 2 model
Armour penetration: 600 mm (23.62 in) for basic model, 700 mm (27.56 in) for Improved TOW, and 800 mm (31.5 in) or more for TOW 2

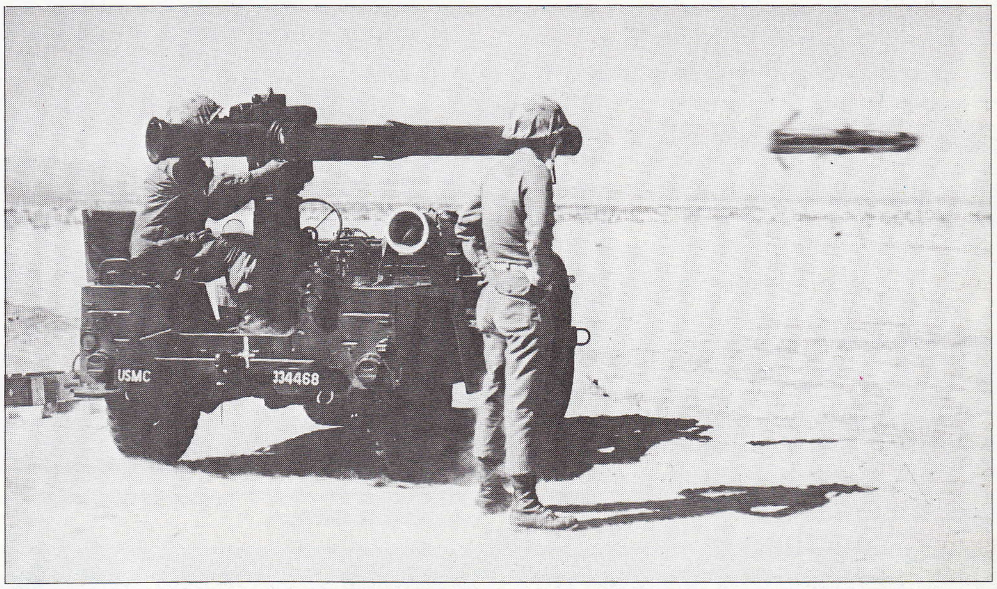
TOW in Action

The most widely used heavy ATGW weapon in the West has seen operational service worldwide since its introduction during the final stage of the American involvement in Vietnam. With successes ranging from that conflict to the Lebanon and Gulf wars, TOW has proved one of the most effective tank-killing weapons of today.

On 15 April 1972 the 1st Combat Aerial TOW Team at Fort Ord, California, was alerted for deployment to Vietnam to give assistance to the beleaguered South Vietnamese government trying to stem the North Vietnamese Easter offensive. The team of three crews for two Bell UH-1B Huey helicopters fitted with the XM26 TOW (Tube-launched Optically-tracked Wire-guided) missile system, and the technical support personnel from Bell Helicopters, Hughes Aircraft and the US Army Missile Command arrived in Saigon nine days later and were immediately shipped out to Pleiku in the central highlands area of Military Region II, where the combat crews began gunnery training under operational conditions. By 2 May they were considered fully trained and the unit began daily flights with the two Hueys in search of the enemy armour reported in the region.

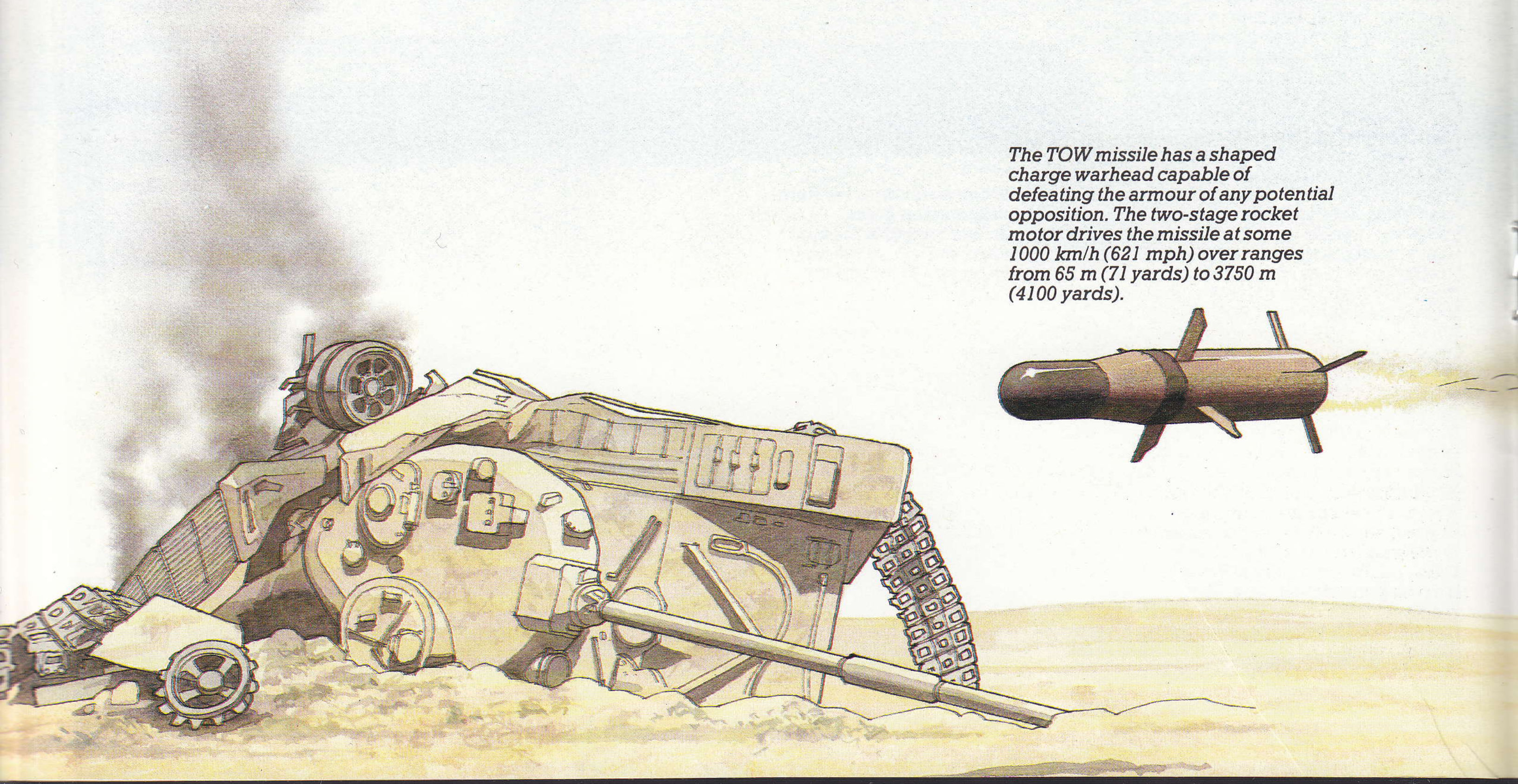
The first contact came on 9 May, when the latest in a series of North Vietnamese tank-led infantry attacks hit the South Vietnamese Ranger camp at Ben Het, located astride a vital supply route used by the North Vietnamese to bring men, ammunition and fuel to their forward-deployed units. In several flights over the camp the team's helicopters destroyed three PT-76 amphibious light tanks with their TOWs and effectively broke the enemy's assault. On 13 May SIGINT radio intercepts confirmed previous air cavalry scout reports that the North Vietnamese were massing armour and two regimental-size units of infantry near Vo Dinh to link up with two more infantry regiments for a divisional attack on Kontum, the region's largest population centre and a provincial capital. At dawn on the following day this attack was launched without artillery support south along Highway QL14. It was an unmitigated failure for the North Vietnamese, most of their 11 supporting tanks being destroyed on the city's outskirts by M722 LAW-equipped tank killer teams from the ARVN 23rd Infantry Division. The remaining tanks fled back up Highway 14 and were picked off by tactical aircraft and the TOW helicopters, which added two T-54 main battle tanks to their score sheet. By 09.00 the attack had petered out with heavy losses to the North Vietnamese in both men and armour.

For the next few days the situation remained relatively static, the enemy using the time to build up its strength for a massive attack. This



The original basic 3000-m (3281-yard) range TOW missile is tested by US Marines in the California desert.

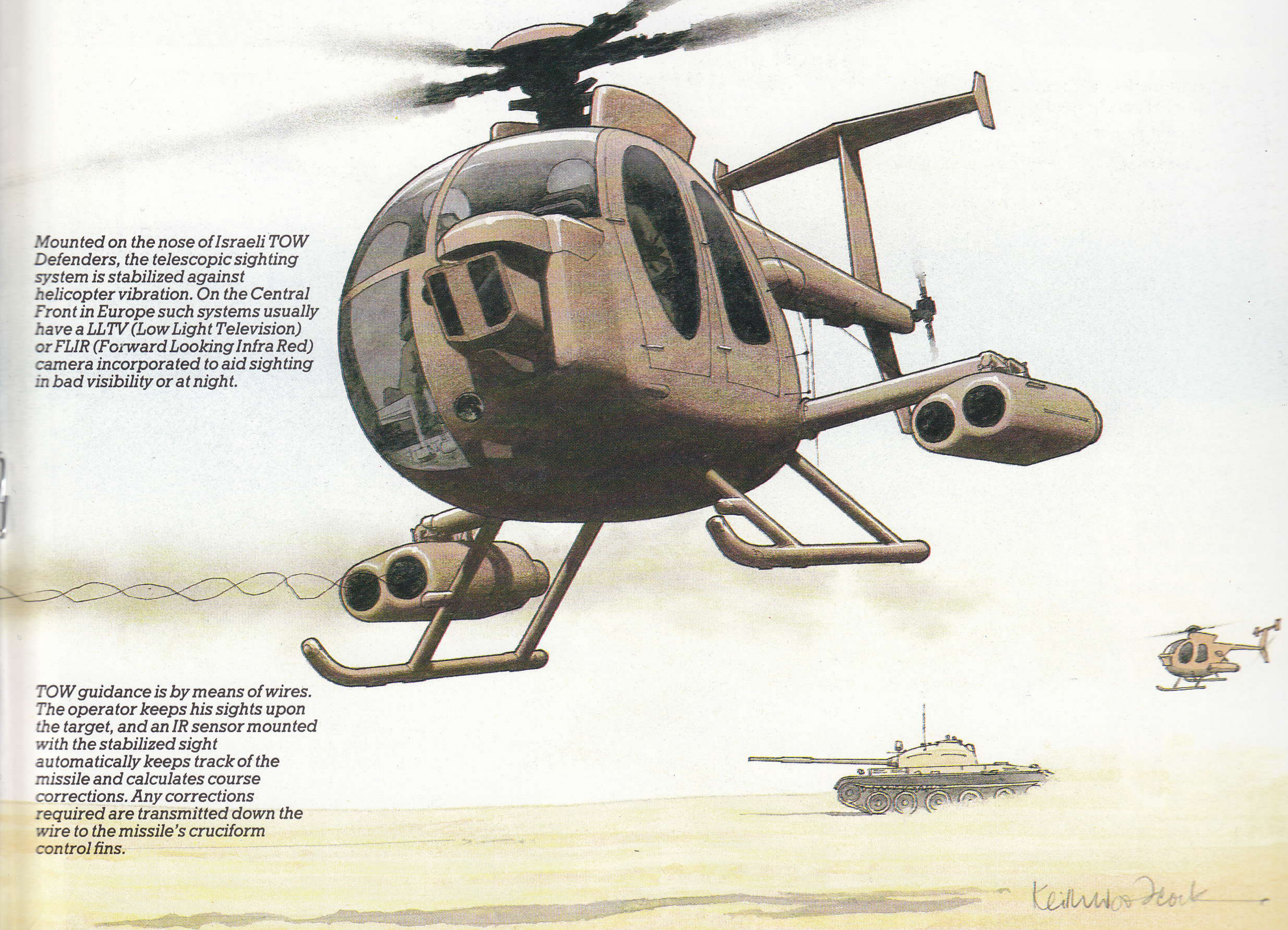
The most effective utilization of TOW has proved to be from dedicated anti-tank helicopters. In Lebanon, Israeli Hughes 500MD Defenders and Bell Cobra gunships destroyed some 80 armoured vehicles, 29 being main battle tanks (including some of the latest Soviet-supplied T-72s) for the loss of only one Cobra.



The TOW missile has a shaped charge warhead capable of defeating the armour of any potential opposition. The two-stage rocket motor drives the missile at some 1000 km/h (621 mph) over ranges from 65 m (71 yards) to 3750 m (4100 yards).

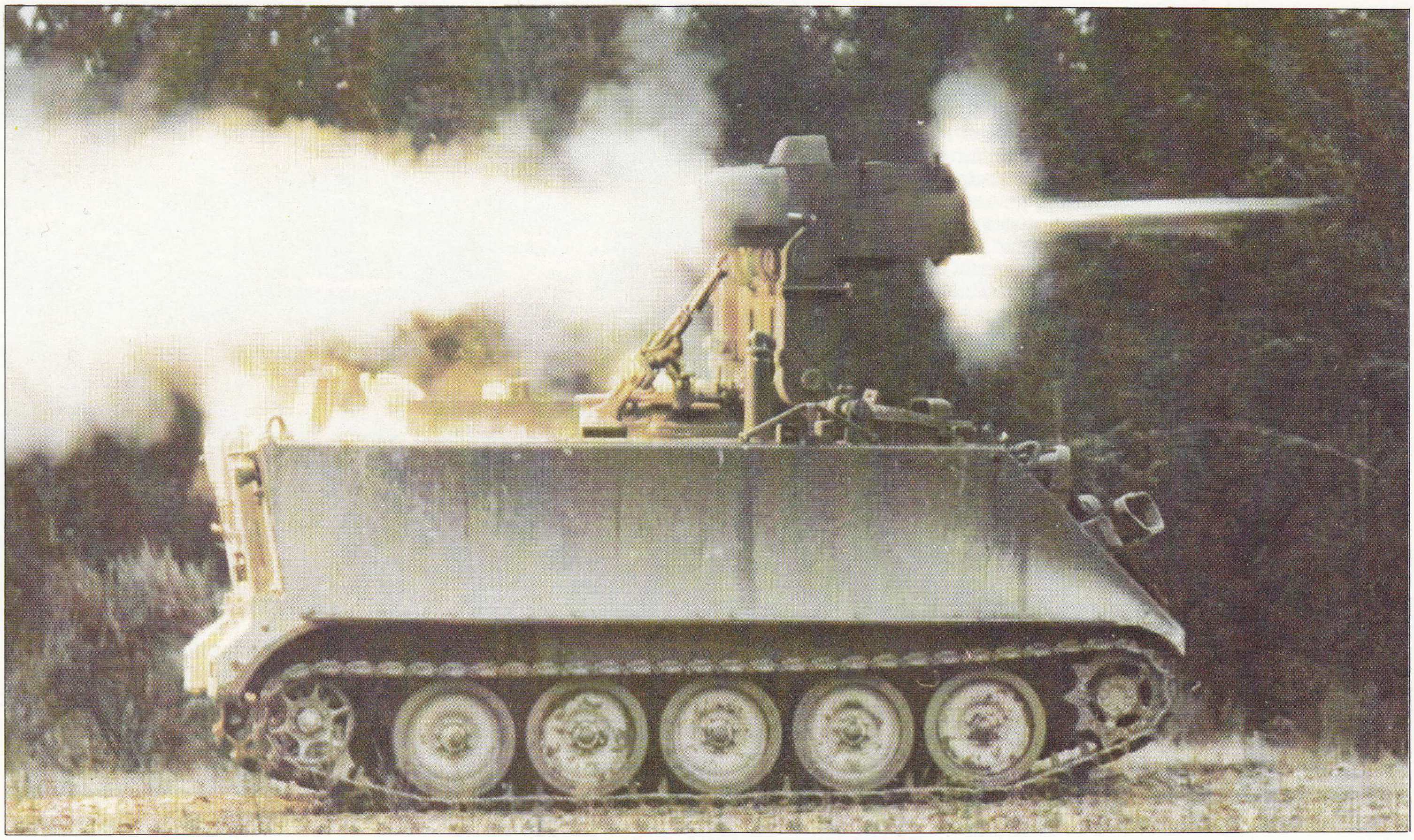
arrived at 01.00 on 26 May, when a tremendous artillery barrage descended upon the city and its defenders. The shelling covered an assault by combined tank and infantry units on the northern sector, and this assault soon achieved several penetrations into the defensive lines. By first light PT-76 and T-54 tanks were roving at will through the northern section of Kontum, the tactical aircraft and gunships being powerless to stop them through fear of causing heavy casualties to friendly forces. It was here that the two TOW helicopters really proved their worth by picking off the enemy tanks one by one in the streets. The first TOW crew flew three sorties, during the day destroying five T-54s and one PT-76, damaging a second PT-76 and, with a single missile, wiping out a particularly troublesome machine-gun post located atop a concrete water tower. The other crew only flew two sorties but managed to destroy three more PT-76s, a truck and another machine-gun unit that had reoccupied the top of the water tower. The effect that these heliborne missiles had on the fighting can be gauged by the fact that only two other enemy tanks were destroyed that day in the city or its vicinity, these falling to ARVN infantry with LAWs. During the following day the helicopters again took to the air, and with the aid of anything that could be thrown into the battle helped the defenders beat off a second North Vietnamese tank and infantry assault that cost the NVA a further seven tanks destroyed. By 31 May the majority of the battered enemy troops had withdrawn,

The Israeli intervention in Lebanon saw TOW used with conspicuous success, adding considerable punch to the lightly armed Jeep-mounted reconnaissance patrols.

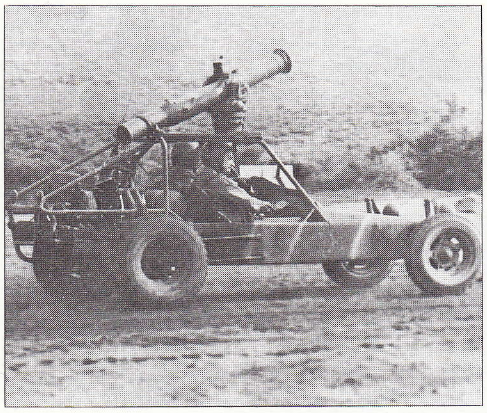


Mounted on the nose of Israeli TOW Defenders, the telescopic sighting system is stabilized against helicopter vibration. On the Central Front in Europe such systems usually have a LLTV (Low Light Television) or FLIR (Forward Looking Infra Red) camera incorporated to aid sighting in bad visibility or at night.

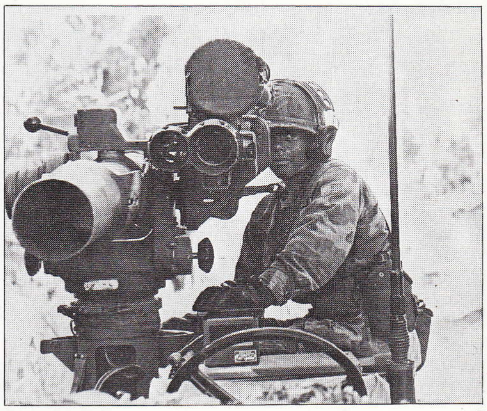
TOW guidance is by means of wires. The operator keeps his sights upon the target, and an IR sensor mounted with the stabilized sight automatically keeps track of the missile and calculates course corrections. Any corrections required are transmitted down the wire to the missile's cruciform control fins.



Above: The M901 Improved TOW vehicle entered service with the US Army in 1979, and is essentially an M113A2 APC fitted with two ready-to-fire missiles with 10 reloads in the hull. It is also in service with Greece, Egypt, Jordan, and Pakistan.



Left: The TOW system has undergone testing on many vehicles, including the Chenowth Dune Buggy seen here with the US Army's 9th Infantry Division at Fort Lewis, Washington State. The Israelis have mounted TOW on the RAM V1 Light AFV for use in desert warfare to give added punch to their reconnaissance units.



Right: A TOW operator needs only to keep his powerful telescopic sight trained on his target, leaving the direction of the missile to the electronic guidance computer built into the sighting unit.

the city being declared clear of North Vietnamese on 9 June. The battle for Kontum had lost the North Vietnamese over 5,500 dead and some 38 tanks destroyed in just over 20 days of fighting.

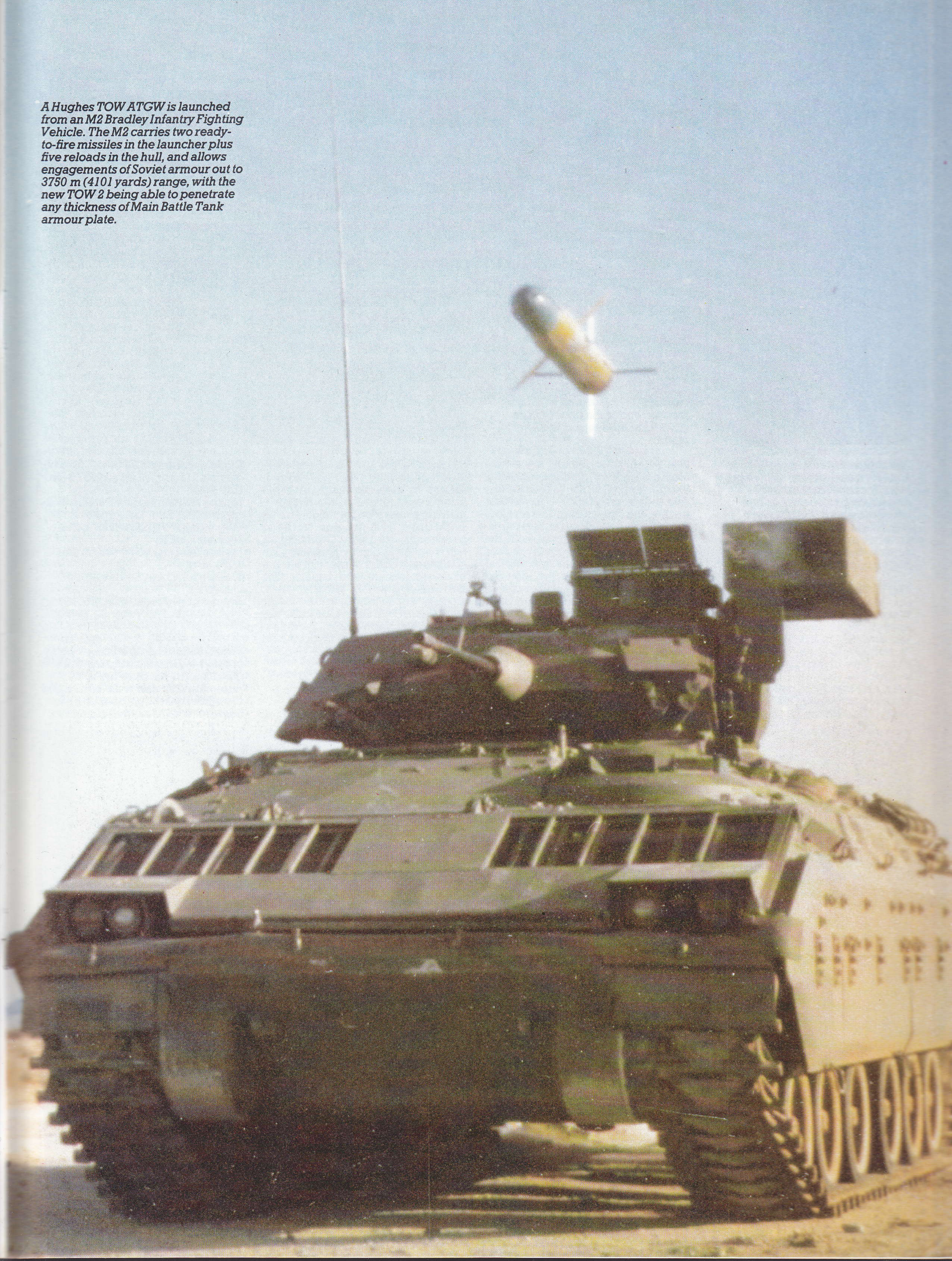
Farther north, on the My Chanh river line defending Hue in the region known as 'the Street without Joy', hastily trained South Vietnamese marines introduced the jeep-mounted TOW system into combat when three battalions of North Vietnamese supported by a battalion of PT-76 light tanks crossed the river on 22/23 May in a suicidal attempt to turn the eastern coastal flank of the northern front. Many of the 18 tanks destroyed by the marines were hit by TOWs, and another five were wiped out by air strikes. The TOW was considered by General Abrams, the US Army commander in Vietnam, as one of the three weapons which had proved to be unqualified successes in the Vietnam War, the other two being the laser-guided bomb and the Lockheed AC-130 Spectre gunship.

The following year saw the TOW involved in another rescue act when it was shipped to the Israelis as part of the USA's emergency arms airlift in the Yom Kippur War. Although it saw relatively limited service, the TOW system so impressed the Israelis that after the war they promptly adopted it as their main air- and vehicle-launched long-range ATGW. In 1982 the Israelis used it to good effect in both roles during the 'Peace for Galilee' invasion of Lebanon against Syrian armour. However, again it was the airborne system that stole the show, Israeli air force Bell AH-1S Cobra and Hughes 500MD Defender gunships being credited with the destruction of 29 tanks, including several of the new T-72 model, and some 50 other armoured vehicles of various types for the loss of only one Cobra. The ground-launched version was used (from both light vehicles and APCs) to destroy a number of other Syrian tanks and armoured vehicles.

However, before this the Iranians were already extensively using the TOW with its ground and helicopter tank-hunting units against Iraq in the Gulf War. Although precise details are hard to determine, TOW is also known to have been used in the air-to-air role against Iraqi air force Mil Mi-24 'Hind-D' assault helicopters during ambushes by those aircraft on the Bell AH-1J Cobra gunships used by the Iranian army. So far no helicopter has been shot down, and the tactics used are thought to be more defensive than offensive in nature, the object being to scare off the 'Hinds'.

TOW has also been used in one other conflict against Soviet-made armour, namely the war in the Sahara that is being waged by the Moroccans against the Algerian-backed Polisario guerrillas. In both its vehicle-launched and AH-1 Cobra gunship versions the TOW has knocked out a number of T-54 tanks and other light armoured vehicles during the periodic Polisario forays into Moroccan-held territory.

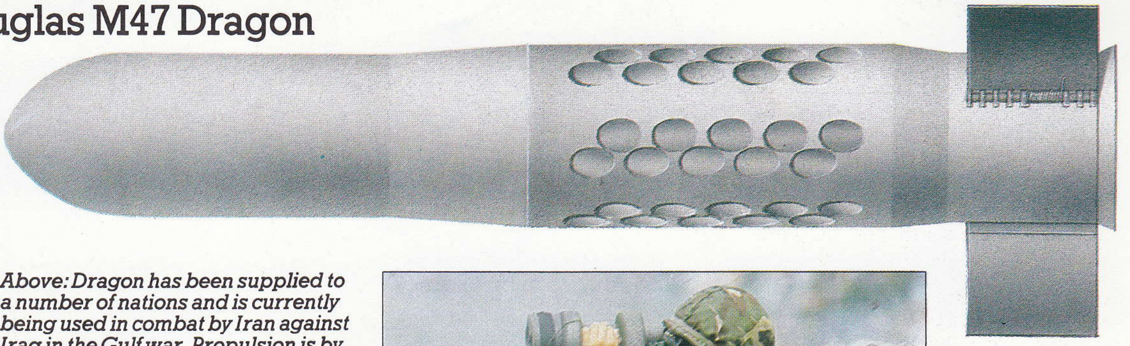
A Hughes TOW ATGW is launched from an M2 Bradley Infantry Fighting Vehicle. The M2 carries two ready-to-fire missiles in the launcher plus five reloads in the hull, and allows engagements of Soviet armour out to 3750 m (4101 yards) range, with the new TOW 2 being able to penetrate any thickness of Main Battle Tank armour plate.



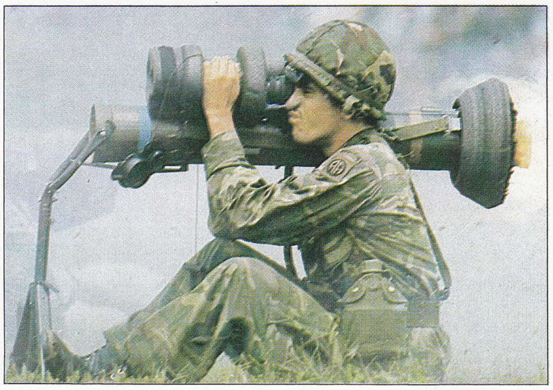
USA

McDonnell Douglas M47 Dragon

The manpack nature of Dragon is ideal for infantry units, as they can literally carry it on their backs around the battlefield. Further improvements to the missile to increase its range and lethality are under investigation in order to counter the current Soviet armour plate laminate types.



Above: Dragon has been supplied to a number of nations and is currently being used in combat by Iran against Iraq in the Gulf war. Propulsion is by 60 small rocket sustainers which fire in pairs and control attitude.



Right: The Dragon Medium Anti-tank/Assault Weapon is a tube-launched, optically tracked wire-guided missile operated by one man, who normally sits with his legs extended forward and the launcher resting on his shoulder, with the forward end of the smooth-bore glass fibre tube supported by a stand.

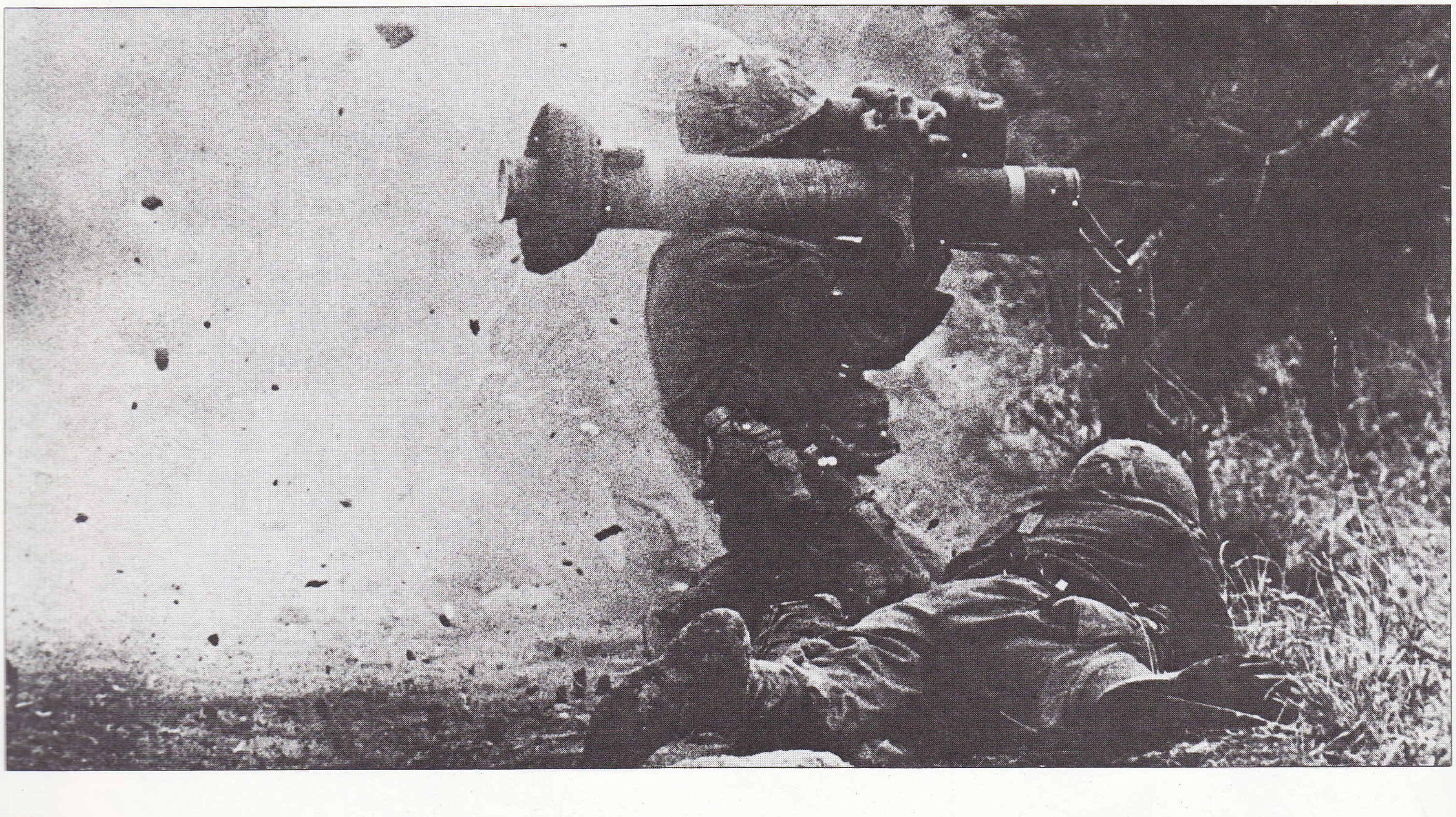
The **McDonnell Douglas M47 Dragon** (or **Medium Anti-tank/Assault Weapon**) was conceived in 1966 when an engineering development contract was awarded to the then McDonnell Aircraft Corporation. In 1972 the go-ahead was given to the follow-on McDonnell Douglas Corporation (MDC) for the first part of a multi-year procurement programme. From Fiscal Year 1975 onwards the procurement was established initially on a two-source basis from MDC and Raytheon, though from 1975 the latter became sole source, with MDC as prime contractor. The Dragon is a one-man tube-launched optically-tracked wire-guided anti-tank weapon, with the front of the smooth-bore fibreglass tube supported on a stand and the firer normally seated with his legs extended forward with the mid-section of the tube resting on his shoulder. Once the missile has been fired the operator has no other task than keeping his cross hairs centred on the target. The missile is tracked in flight by a sensor that monitors the output from an infra-red transmitter on the missile's tail, and the displacement of this from the line of sight is measured. Any corrective commands are then sent via the wire.

Recently a 4.5-kg (9.9-lb) thermal-imaging sight has been put into production to give the missile a night-firing capability. Further improvements to achieve longer range, shorter flight time and greater warhead penetration are under investigation. Since its initial deployment, the Dragon has seen combat use with the Iranians, Moroccans and Israelis. The Dragon system is widely used, amongst the known operators being Iran, Israel, Jordan, Morocco, the Netherlands, North Yemen, Saudi Arabia, Spain, Switzerland, Thailand and the USA.

Specification

M47 Dragon
Type: anti-tank missile
Dimensions: length 0.744 m (2 ft 5.3 in); diameter 12.7 cm (5 in); span 33.0 cm (1 ft 1 in)
Launch weight: missile 6.2 kg (13.66 lb) and whole system 13.8 kg (30.4 lb)
Propulsion: solid-propellant rocket after gas launch
Performance: range 75-1000 m (82-1,095 yards)
Warhead: 2.45-kg (5.4-lb) shaped-charge HE
Armour penetration: 600 mm (23.62 in)

The considerable debris and blast created by Dragon firing is evident in this photograph. Once fired, the fibreglass launcher is discarded and the tracking unit is clipped to a new launcher with its sealed-in missile.



SWITZERLAND

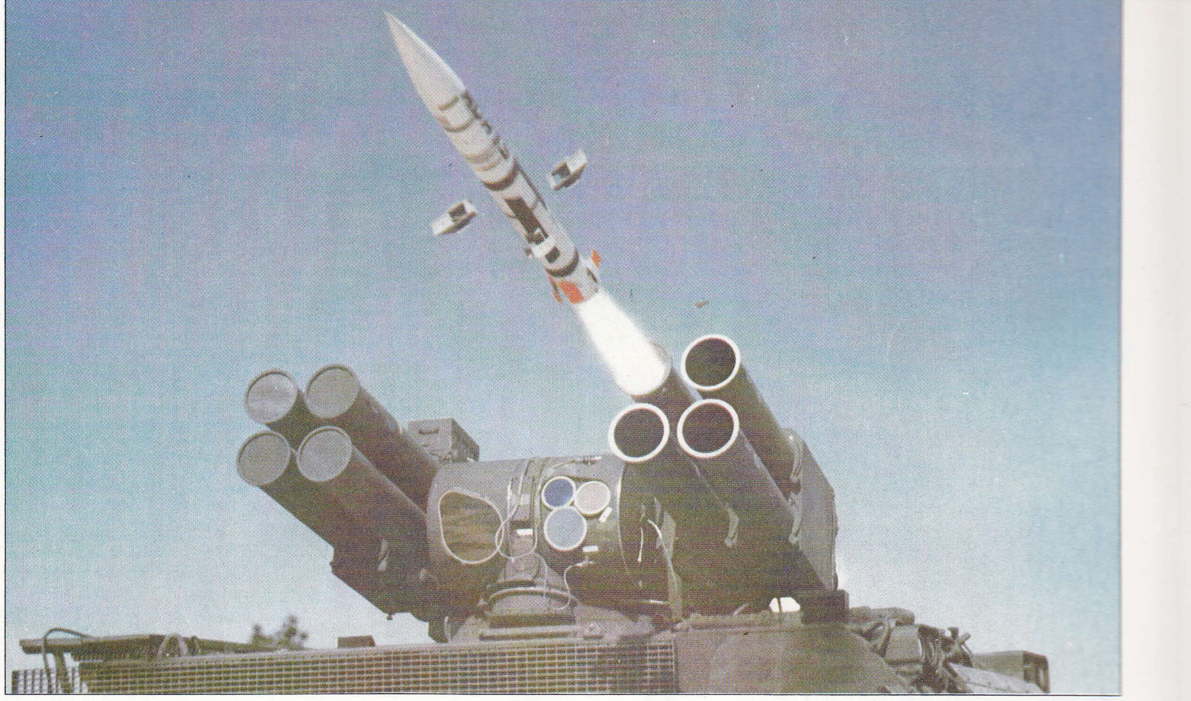
ADATS

The **Air Defence Anti-Tank System (ADATS)** has been developed from 1979 by Oerlikon-Bührle specifically as a private venture for the export market. Prime contractor for the missile is Martin Marietta of the USA. By 1983 three prototypes of ADATS had been completed, two mounted on the chassis of the well known FMC M113A2 full-tracked armoured personnel carrier and the third ready for installation on a variety of tracked and wheeled chassis as specified by the user; for example, the American 6×6 Cadillac Gage V-300 Commando. It is envisaged that the user would use the system primarily as an air-defence system with a secondary anti-tank capability, or vice-versa.

The main part of the system is a power-operated turret that can be traversed through 360°, with the operator seated under cover between two banks of four missiles in launch containers. The latter can be elevated to +85° and depressed to −5°. The surveillance radar is mounted on the rear of the turret, the FLIR, TV tracker, laser rangefinder and missile guidance laser all being mounted in the forward part of the turret.

A typical aircraft target engagement would take place as follows. The airborne target is first detected by the Contraves Italiana surveillance radar (mounted on the turret rear), this being capable of detecting targets up to a maximum height of 5000 m (16,405 ft) and out to a maximum range of 20 km (12.4 miles). The radar first detects the target which, if confirmed as hostile, appears on the radar operator's PPI (plan position indicator) display. The radar operator is seated within the vehicle. The turret is then automatically traversed in bearing and search is initiated by the gunner to bring the target into the field of view of the FLIR or TV camera, the choice between the two sensors depending on the weather conditions at the time of the engagement; TV is used only in fair conditions. The sensor selected then locks onto the target and commences tracking. The target range is measured by the laser rangefinder to ensure that a missile is not launched if the target is not within range. Once the target is within range a missile is launched, riding along the missile-guidance radar beam until it impacts with the target.

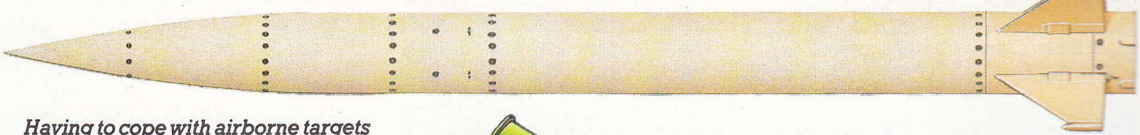
The missile is carried in a launch/transport container which weighs 65 kg (143 lb) complete with missile. The latter has a Mach 3+ performance on its smokeless propellant motor, no wings and four control fins. It is fitted with a hollow-charge (HEAT) warhead that weighs 12 kg (26 lb) and gives a good fragmentation effect against aircraft. According to Oerlikon the missile's warhead will also penetrate over 900 mm (35.4 in) of armour. Two fuses are fitted, an impact type for ground targets and an electro-optical proximity type for aircraft targets. Engagement of ground targets is similar to that of aerial targets except that the target is first detected by FLIR or TV tracker with the laser rangefinder being used to determine target range. When being used against ground targets minimum and maximum ranges are 500 and 6000 m (545 and 6,560 yards respectively.



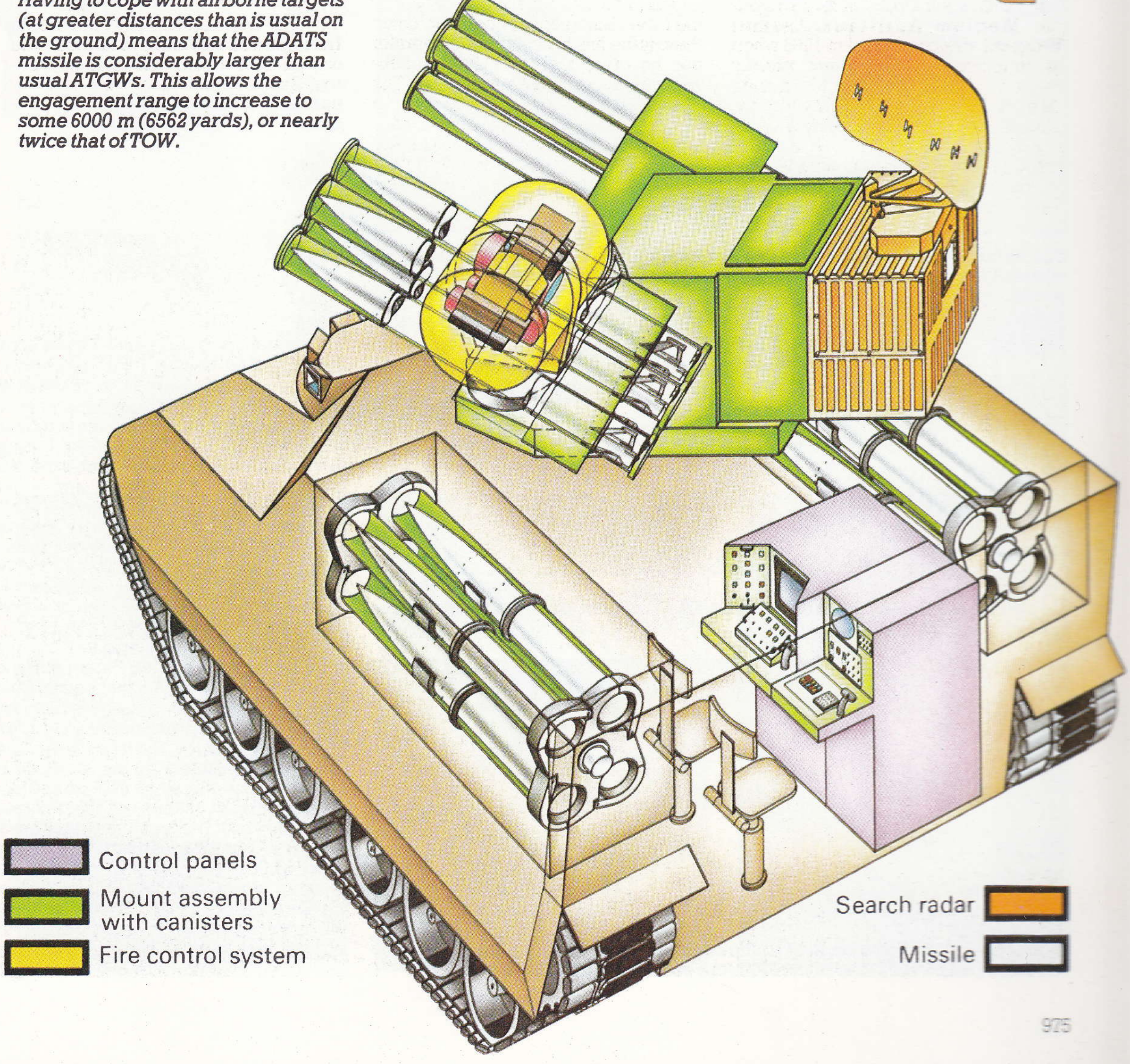
Above: One of the two M113A2 ADATS prototypes launches a missile. The minimum and maximum ranges for an anti-tank engagement are 500 m (547 yards) and 6000 m (6562 yards) respectively.

Specification

ADATS missile
Length: 2.05 m (6 ft 8.7 in)
Diameter: 15.2 cm (5.98 in)
Launch weight: 51 kg (112 lb)
Range: 8000 m (8,750 yards)
Altitude: 5000 m (16,405 ft)



Having to cope with airborne targets (at greater distances than is usual on the ground) means that the ADATS missile is considerably larger than usual ATGWs. This allows the engagement range to increase to some 6000 m (6562 yards), or nearly twice that of TOW.



Designed as a dual role air defence anti-tank missile system, ADATS consists of a 360° traversable turret with surveillance devices and eight ready-to-fire missile container-launchers that can be mounted on a variety of wheeled or tracked vehicles, such as the M113APC.

US Long-Range Anti-Tank Systems

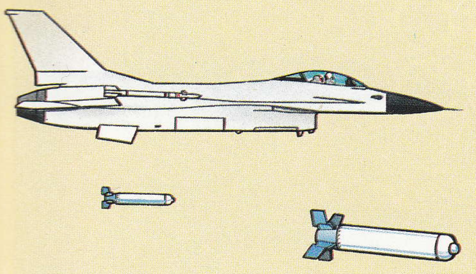
In any conflict on the Central Front in Europe, NATO forces would be considerably outnumbered in terms of armour by the Warsaw Pact. Attempts to counter the problem have made use of the West's technological advantage, and nowhere is this better displayed than in American long-range, wide-area anti-armour systems.

Probably the best known of the USA's futuristic long-range anti-tank systems is that with the codename Assault Breaker, which is a US Army programme of studies and projects with the ultimate objective of providing a weapon (or series of weapons) that will be able effectively to counter the very large numbers of armoured vehicles which form the Soviets' second or main reinforcement echelon at distances well behind the forward edge of the battle area (FEBA). Assault Breaker and the complementary US Air Force Wide Area Anti-Armor (WAAM) project are in fact part of a much larger combined programme of research being undertaken by the US Defense Advanced Research Projects Agency (DARPA). The ultimate Assault Breaker weapon will be able to engage numerous targets at ranges of between 20 and 200 km (12.4 and 124 miles) behind the FEBA. Target information will be generated by the specially developed Joint Surveillance and Target Attack Radar in conjunction with other theatre-wide reconnaissance and target-designation platforms.

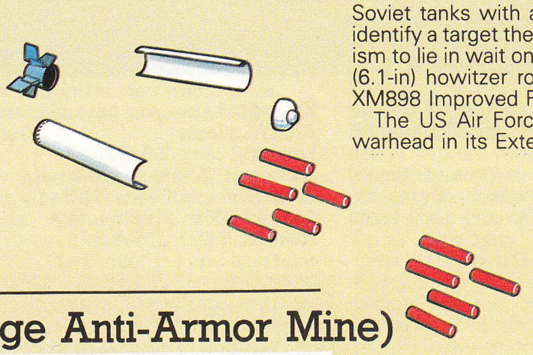
To meet the stringent criteria of the programme the favoured delivery system is a missile carrying a number of 'smart' infra-red terminally-guided submunitions. One of these, the Avco Skeet, is also used in another US Army long-range anti-tank system, the Sense and Destroy Armor (SADARM) M438 artillery round: this carries six modified Skeets and is intended to be fired from the M110 series of self-propelled howitzers to a range of 25-30 km (15.5-18.6 miles). The Skeet as used in SADARM is designed either to attack the top armour of the Soviet tanks with a Self-Forging Fragment (SFF) warhead or, if that fails, to identify a target then to land and by using a novel top or bottom attack mechanism to lie in wait on the ground as a normal run-over anti-tank mine. A 155-mm (6.1-in) howitzer round with six modified Skeets is being developed as the XM898 Improved Remote-Area Anti-Armor Mine System (IRAAMS).

The US Air Force's WAAM programme also uses the Skeet and its SFF warhead in its Extended-Range Anti-Armor Mine (ERAM), of which hundreds will be scattered (from nine-round containers carried by low-level aircraft) over the projected line of march of enemy second-echelon armoured units. Each mine will be able to detect a target at around 150-m (165-yard) range and then, by projecting a Skeet submunition into the air, engage it at a range of 10-15 m (33-49 ft) from the Skeet's detonation point. According to the US Air Force each mine will be capable of two such engagements. For more normal extended-range air strikes against Soviet armour tactical aircraft will use two more WAAM developments, an updated anti-armor Cluster Munition (ACM) carrying 40 Skeet-type retarded submunitions, and podded clusters of Wasp mini-missiles that after launch will fly under preprogrammed guidance to the target area, where their terminal homing systems will identify the armoured vehicles and direct each missile to attack an individual target, a shaped-charge warhead destroying it. The Wasps will be used in those areas where extensive Soviet anti-aircraft defences are found in order to give the launching aircraft some measure of survivability.

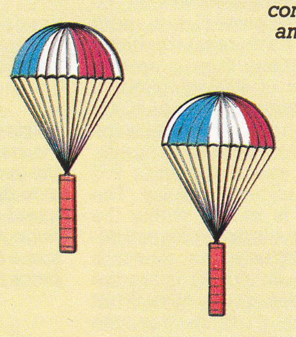
The missiles that have so far been tested for the Assault Breaker mission are the T-16, a variant of the Patriot surface-to-air missile, and the T-22, a modified version of the Lance nuclear-capable battlefield support missile. Each is capable of carrying a number of General Dynamics infra-red terminally-guided submunitions (TGSMs) or Skeet delivery vehicles. The latter are ejected in sequence over the target zone, where they are slowed by parachute and stabilized in their downward trajectory by four wrap-around fins before the spin-up manoeuvre is started. Once the small spin-up motors have fired, the anti-clockwise rotation thus generated causes the fins to close and the parachute to be jettisoned. At motor burn-out the first two of the four Skeet submunitions carried are released, followed soon afterwards by the second pair. Each Skeet has a rotation speed of about 3,000 rpm and a velocity of around 60 km/h (37 mph). The infra-red sensors of the individual Skeets then scan the ground beneath them out to an angle of about 30° from the vertical and with an acquisition radius of around 75 m (82 yards). If a target is detected then the SFF warhead is triggered to strike the enemy vehicle's thin upper armour at a velocity in the region of 2100-3000 m (6,890-9,845 ft) per second; if no target is located the Skeet is programmed to



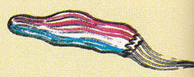
Evolved from existing cluster bomb technology, Anti-Armor Cluster Munitions (ACM) would normally be released in a low-level delivery pass. The ACM canister contains a large number of submunitions.



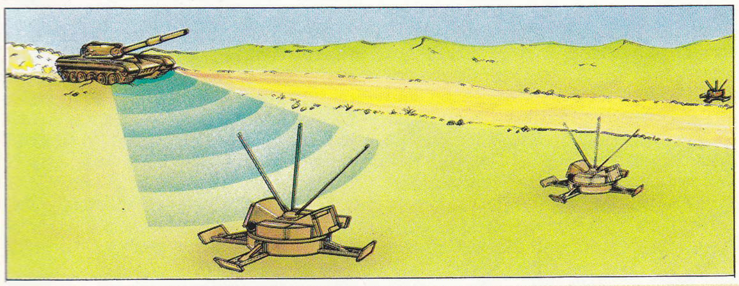
Once launched, each ACM canister disgorges a number of Avco Skeet infra-red, terminally-guided submunitions, each containing several anti-tank devices.



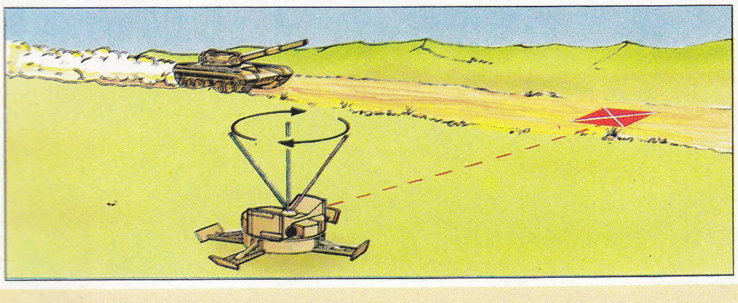
The Skeets are slowed by parachute and stabilized by wrap-around fins. The munition is then spun to jettison parachute and fins.



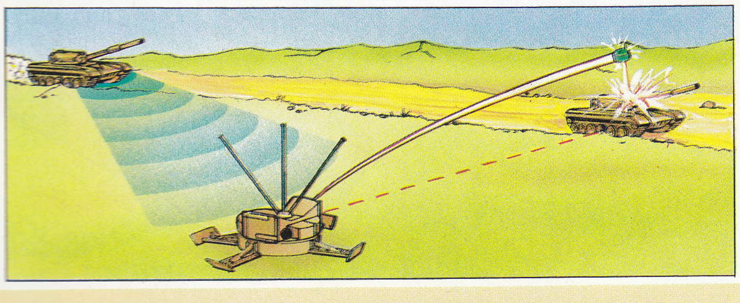
ERAM (Extended Range Anti-Armor Mine)



Scattered in nine round batches by low-flying aircraft over enemy second echelon and lines of communication, ERAM can detect armour at 150 m (165 yards).



On detection of the approaching vehicle, ERAM rotates to bring its weaponry to bear close to the target.



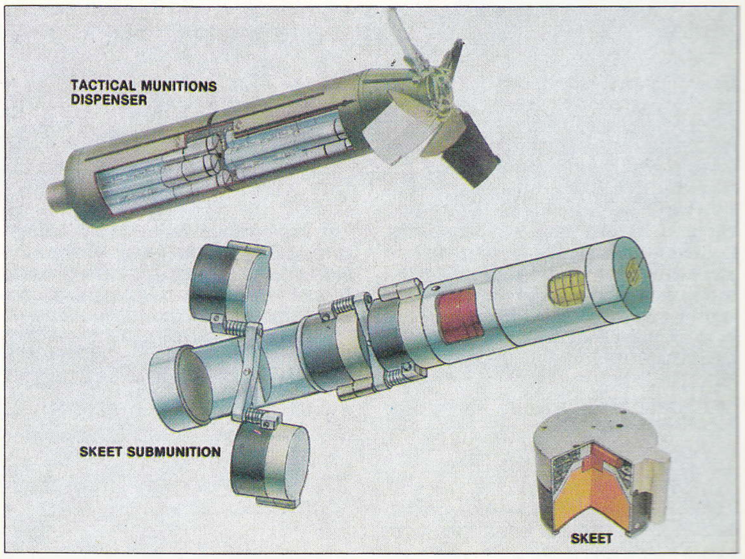
Explosively launched from ERAM, one of two Skeet submunitions locks on to the target, and from some 10 m (11 yards) the SFF warhead detonates.

explode at a fixed altitude above the ground to ensure that maximum damage is inflicted on any personnel or matériel within its effective fragmentation radius.

The TGSM payloads are ejected individually at specified altitudes over the target zone. A tail system extends to stabilize the airframe and, after a preset interval, a parachute is released to slow the TGSM. Wings are then deployed and the infra-red seeker begins a conical-scan search of the ground below. When a valid target is detected a drag device is activated and the TGSM steers itself to impact the target. It has the ability to manoeuvre towards any vehicle within its seeker's line of sight. A hollow-charge warhead then detonates to destroy the enemy vehicle.

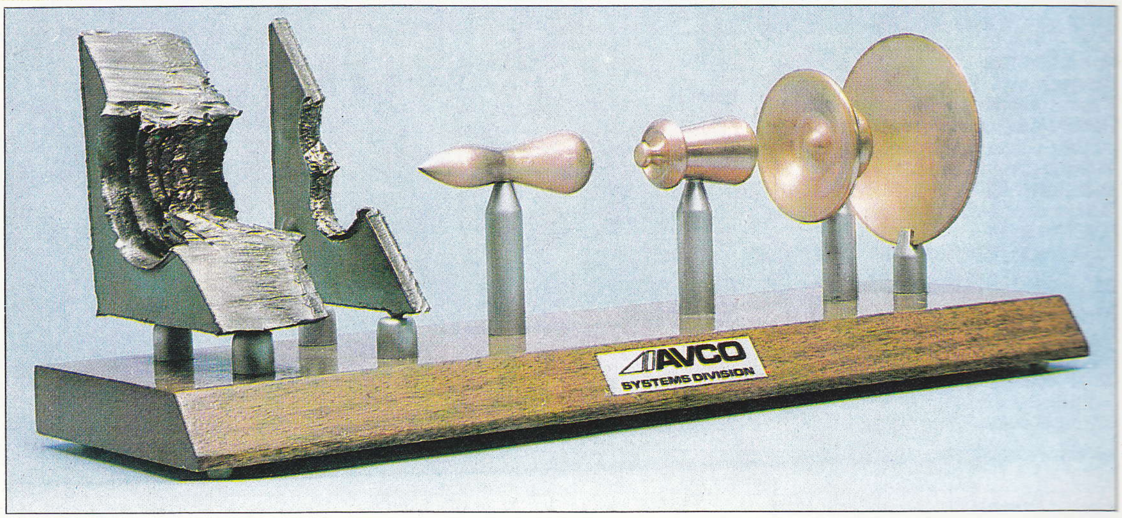
For those armoured targets which manage to evade the above systems, the US Army has deployed a 155-mm (6.1-in) artillery round capable of successfully engaging manoeuvring targets near to or on the battlefield itself. Known as the M712 Copperhead, this has a laser seeker in its nose capable of withstanding the very high g-forces imposed as the round is fired. The seeker homes on the energy (from a ground or airborne laser designator) reflected from an illuminated target. With a minimum range of 3 km (1.9 miles) and a maximum of 16 km (9.9 miles) the Copperhead bridges the gap between the HAWs and Assault Breaker.

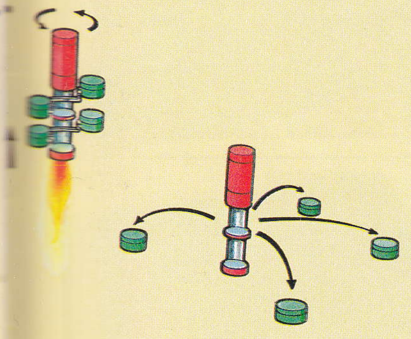
Finally, further to improve their helicopter-borne ATGW capabilities the Americans have recently introduced the Hellfire Modular Missile System (HMMS) into service. This uses both laser and imaging infra-red seekers in its anti-tank version, and is carried by both the Hughes AH-64 and Bell AH-1 Cobra helicopter gunship. The Hellfire is not limited to direct-fire situations and can be launched in a variety of indirect fire modes without seeker lock-on. For instance, it can be launched to climb over an obstacle and then search for a target that is being illuminated by a third-party designator. Once lock-on is achieved, the Hellfire impacts with no degradation in terminal accuracy. Multiple engagements can be undertaken at the same time using designators with separate coding systems, although if only one designator is available multiple targets can still be engaged by temporal sequencing of the missiles. With a 9-kg (19.8-lb) hollow-charge warhead and a range estimated at 8-10 km (5-6.2 miles), the Hellfire can take on and defeat all current and projected main battle tanks. The imaging infra-red seeker (when deployed) will give the missile a true launch-and-forget capability. If everything goes according to plan then the US armed services will be able to boast the best-equipped anti-armour forces in the world by the early 1990s, which is perhaps just as well as the Soviets will by then have the world's best-equipped armoured forces.



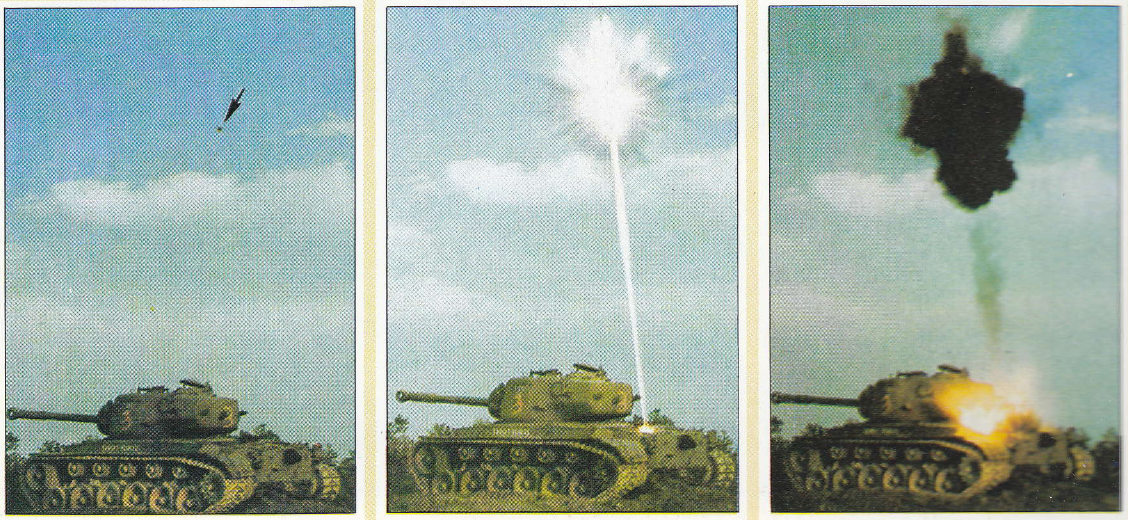
***Above:** An example of a Skeet delivery system, the retarded cluster bomb type of tactical munitions dispenser contains a number of Skeet submunitions, each containing four Skeets, mounted on extending arms, and a parachute and spin rocket at one end. The Skeet itself contains an infra-red sensor and a shaped charge, which explosively forges a thin copper disc into an armour-piercing projectile.*

The Self-Forging Fragment (SFF) warhead utilizes the power of its own explosion to forge a kinetic energy penetrator. As shown below, a concave copper disc is ejected with great energy from a munition, deforming on the way to develop a projectile-like form. This is capable of holing several inches of armour plate from a distance of up to 15 m (50 ft) from the target.





Once the motor burns out, the individual anti-armour munitions are released two at a time, each rotating and scanning the ground beneath for targets.



***Right:** Once an armoured target has been detected, a Self-Forging Fragment (SFF) warhead is triggered to strike at the relatively thin upper armour of the enemy tank. Acquisition range is around 75 m (82 yards), and the velocity of the warhead after explosion can reach a maximum 3000 m (3,282 yards) per second.*

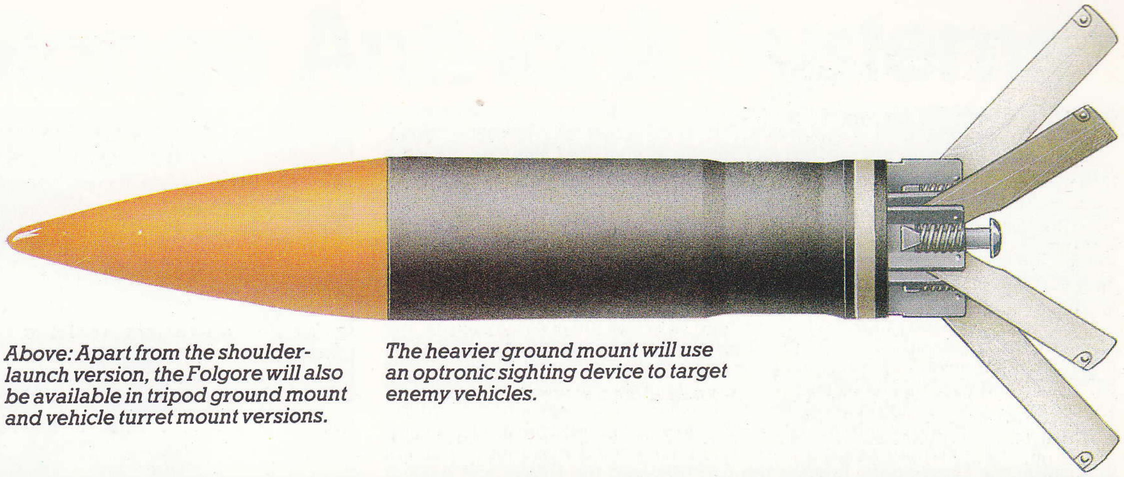
ITALY

Breda Folgore

The **Breda Folgore** is a modern recoilless anti-tank rocket-launcher under advanced development by Breda Meccanica Bresciana for use in the shoulder-, tripod- or vehicle-mounted roles to a maximum range of 1000 m (1,095 yards) without too much effort in interchanging the systems. For the shoulder role it is normally operated by a two-man team, but can if required be used by one man only. A special lightweight optical sighting device and a bipod are used. In the case of the tripod mounting a larger optronic sight is provided in order to enable the aimer to estimate within a few seconds the target's range, speed and angle of elevation. The vehicle mounting is normally external to a small turret on a reconnaissance vehicle or APC with either of the sights mentioned above. The ammunition is the same in all three systems, and comprises a fin-stabilized hollow-charge rocket with a simple low pressure recoilless launching cartridge that both fires the rocket clear of the tube and brings it up to a speed sufficient for its own double-base propellant motor to ignite and sustain the forward motion. The fusing utilizes an electrical double-safety system that is initially operated when the projectile attains a fixed acceleration rate and secondly when it strikes the target, thus considerably reducing the possibility of a premature explosion. The Folgore is currently undergoing final field trials and it is not known yet whether the weapon has been adopted by any nation.

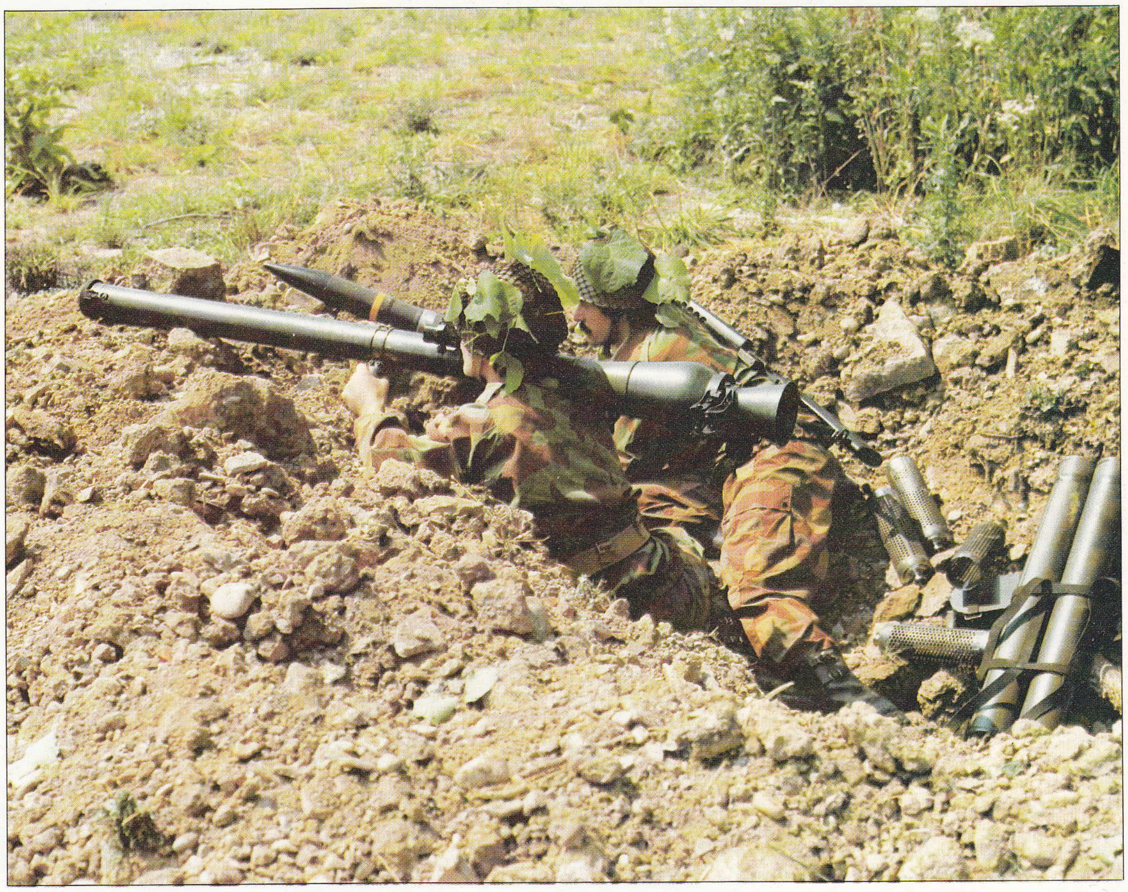
Specification

Folgore
Type: anti-tank rocket-launcher
Dimensions: length 1.85 m (6 ft 0.83 in); calibre 8.0 cm (3.15 in)
Weight: shoulder model 17 kg (37.5 lb) and tripod model 27 kg (59.5 lb)
Performance: effective range 50-700 m (55-765 yards)
Ammunition: 3-kg (6.6-lb) hollow-charge rocket with 2.2-kg (4.85-lb) ejection round
Armour penetration: not known



Above: Apart from the shoulder-launch version, the Folgore will also be available in tripod ground mount and vehicle turret mount versions.

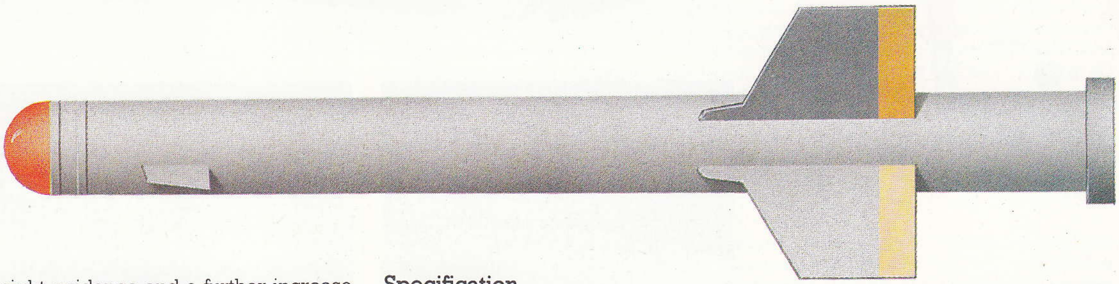
The heavier ground mount will use an optronic sighting device to target enemy vehicles.



The Folgore shoulder-launch variant has an optical sighting device and is effective out to 700 m (766 yards).

USSR

AT-2 'Swatter'



The **AT-2 'Swatter'** was the second of the Soviet first-generation ATGWs to be identified. It is a manually-guided command to line of sight vehicle- and helicopter-mounted system known to the Soviets as the **PTUR-62 'Falanga'**. It is unusual among ATGWs in having a UHF radio command guidance link with three possible frequencies for ECCM purposes. It is at its most effective when launched directly at the target but can, if required, be switched from one target to another as long as the new one is within the field of fire. The missile arms itself when it reaches 500 m (545 yards) from the launcher. In a later **'Swatter-B'** version the maximum range was increased from the 3000 m (3,280 yards) of the original **'Swatter-A'** to 3500 m (3,830 yards). A **'Swatter-C'** version is now used on the Mil Mi-24 'Hind-A' and 'Hind-D' gunship helicopters (four rounds), with semi-automatic command to line of sight guidance and a further increase in maximum range to 4000 m (4,375 yards). All three versions are used on BRDM-1 and BRDM-2 scout car conversions in quadruple mounts. The 'Swatter' is now being replaced by more modern systems, and as far as it is known has never been used in combat, although 'Hind A' and 'Hind-D' helicopters have been seen carrying the type in Afghanistan. Countries that use the 'Swatter' are Bulgaria, Cuba, Czechoslovakia, East Germany, Egypt, Hungary, Libya, Poland, Romania, South Yemen, Syria and the USSR.

Specification

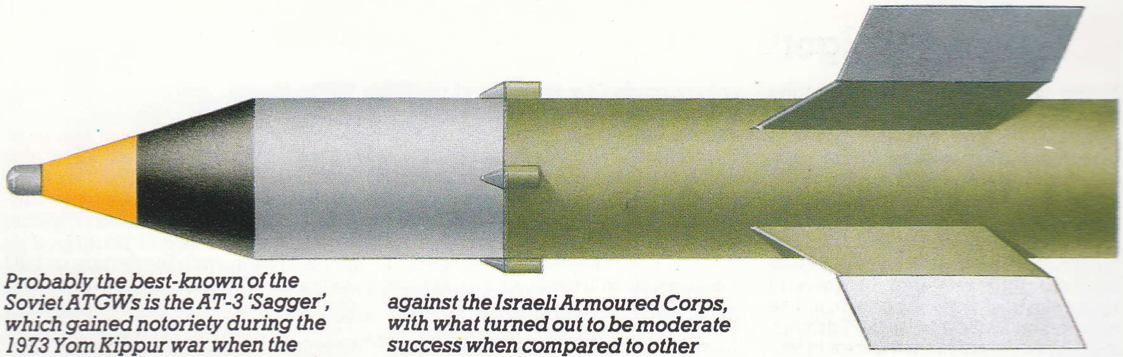
AT-2 'Swatter'
Type: anti-tank missile
Dimensions: length 1.14 m (3 ft 8.88 in); diameter 13.2 cm (5.2 in); span 66.0 cm (2 ft 2 in)
Launch weight: 'Swatter-A' 26.5 kg (58.4 lb), 'Swatter-B' 29.5 kg (65 lb) and 'Swatter-C' 32.5 kg (71.65 lb)
Propulsion: solid-propellant rocket
Performance: range 'Swatter-A' 500-3000 m (545-3,280 yards), 'Swatter-B' 500-3500 m (545-3,825 yards) and 'Swatter-C' 250-4000 m (275-4,375 yards)

The AT-2 'Swatter' was the second of the Soviet first-generation ATGWs to be named by NATO. It is currently used on the Mil Mi-24 'Hind-D' assault helicopter in the 'Swatter-C' variant with a semi-active command to a line-of-sight guidance system, out to a maximum effective range of some 4000 m (4374 yards).

Warhead: hollow-charge HE
Armour penetration: 'Swatter-A' 480 mm (18.9 in) and 'Swatter-B/C' 510 mm (20.08 in)

USSR

AT-3 'Sagger'



Probably the best-known of the Soviet ATGWs is the AT-3 'Sagger', which gained notoriety during the 1973 Yom Kippur war when the Egyptians fired several thousand against the Israeli Armoured Corps, with what turned out to be moderate success when compared to other anti-tank systems.

The **AT-3 'Sagger'** is known to the Soviets as the **PTUR-64 'Malatyuka'**, and until recently was their standard domestic and export ATGW. It was produced in three versions, the optically-tracked manually wire-guided **Sagger-A'**, the **'Sagger-B'** which came into service in late 1973 and has an improved propulsion motor to make it 25 per cent faster, and the **'Sagger-C'** which is the 'Sagger-B' with semi-automatic guidance and entered service in the late 1970s. The 'Sagger' is used in a number of ways, that most often encountered being the three-man team carrying two rounds and the control unit. The 'Sagger' is also used on sextuple launchers on the BRDM-1 (with no reloads) and the BRDM-2 (with eight reloads) tank destroyers. Single-rail launchers are fitted to the BMP-1 and BMD infantry combat vehicles (with four reloads each) for self-defence. The missile, believed to be the 'Sagger-B' and 'Sagger-C' versions, is also carried on the Mil Mi-2 'Hoplite', Mi-8 'Hip' and Mi-24 'Hind' helicopters of the Warsaw Pact and allies, whilst the Yugoslavs have mated it to the Aérospatiale SA 342 Gazelle and their indigenous BOV-1 armoured vehicle on sextuple launcher (with six reloads). Other vehicle mounts include a modified East German BTR-40 APC and the Czech OT-64 APC. The missile has seen extensive combat service with many nations. The Arabs used it against the Israelis in the War of Attrition, the 1973 Yom Kippur War and the 1982 'Peace for Galilee' campaign. The North Vietnamese have used it against the South Vietnamese, Americans and Chinese in Indo-China, and the Iraqis have deployed the weapon extensively against Iranian targets in the Gulf War from the ground, vehicles and 'Hind-D' helicopters. Although not given the missile before their ideological split with the Soviets, the Chinese have since copied the type, and the Taiwanese have used it as the basis of their **Kun Wu** ATGW. The AT-3 'Sagger' is widely employed, known operators being Algeria, Angola, Bulgaria, China (unlicensed copy), Cuba, Czechoslovakia, East Germany, Egypt, Ethiopia, Hungary, India, Iraq, Israel, Libya, Mozambique, North Korea, Poland, Romania, South Yemen, Syria, Taiwan (unlicensed copy), USSR, Vietnam and Yugoslavia.

Specification

AT-3 'Sagger'

Type: anti-tank missile

Dimensions: length 0.883 m (2 ft 10.76 in); diameter 11.9 cm (4.69 in); span not known

Launch weight: 11.29 kg (24.9 lb)

Propulsion: two-stage solid-propellant rocket

Performance: range 300-3000 m (330-3,280 yards)

Warhead: 3-kg (6.6-lb) hollow-charge HE

Armour penetration: 410 mm (16.14 in) or more

Above: A Soviet army AT-3 'Sagger-B' mounted on the launcher rail above the 73-mm gun of a BMP-1 infantry combat vehicle.

Below: A three-man infantry 'Sagger' team can deploy four missiles, checked and ready to fire, in between 12 and 15 minutes.

USSR

AT-4 'Spigot'

In the late 1970s persistent reports circulated about a new Soviet second-generation man-portable tripod-mounted ATGW with semi-automatic command to line of sight guidance. By 1980 the first photographs had appeared of the NATO-designated **AT-4 'Spigot'** system, which is believed to be called **'Faggot'** by the Soviets. The fact that in general appearance and operation the weapon is very similar to the Euromissile MILAN is more than coincidental, recent reports from the USA suggesting that the 'Spigot' is based on technology gained by spying and on the examination of actual specimens gained from third parties friendly to the Soviets. The main outward differences are that the AT-4's sight is smaller and that the guidance computer and goniometer are located in a box below the launch rail. By 1984 all of the most trusted Warsaw Pact Allies had been issued with the 'Spigot' to replace the 'Sagger' in the manpack role, the three-man team now carrying four rounds, sight and a tripod mount. More recently the 'Spigot' has been seen in East Germany on BRDM-2/'Spandrel' vehicles on the two outermost (of five) launcher positions to give the vehicle a new missile load of six AT-5 'Spandrel' and eight 'Spigot' missiles. It has also been seen on some BMP-1 and BMD armoured vehicles replacing the 'Sagger' system; the same reload capacity is assumed. The 'Spigot' underwent its baptism of fire with the Syrians in 1982 against the Israelis, and several samples were said to have been captured. The AT-4 'Spigot' system is used by Czechoslovakia, East Germany, Hungary, Poland, Syria, USSR and several other countries.

Specification

AT-4 'Spigot'
Type: anti-tank missile
Dimensions: not known
Launch weight: total system 40 kg (88.2 lb)
Propulsion: solid-propellant rocket
Performance: range 25-2000 m (27-2,190 yards)
Warhead: shaped charge HE
Armour penetration: 600 m (23.62 in) or more

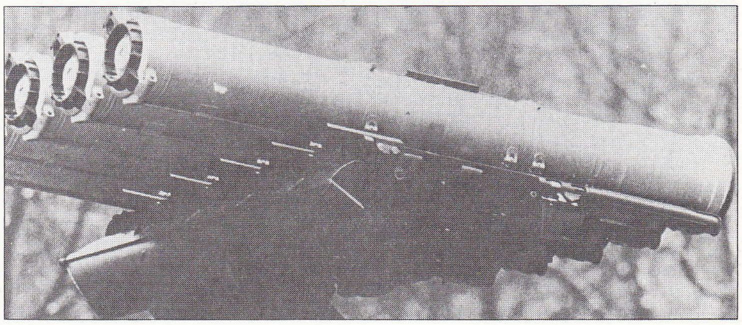
USSR

AT-5 'Spandrel'

The **AT-5 'Spandrel'** is a second-generation Soviet ATGW equivalent to the Euromissile HOT, and generally seen on BRDM-2 vehicles, on which the type is mounted in a quintuple launcher-tube assembly with a separate optical day and night tracking system on the vehicle's roof. A further five rounds are carried inside the vehicle as reloads. The BRDM-2 is replacing the older BRDM tank destroyer vehicles in the anti-tank companies of the Soviet units facing NATO and in Category 1 divisions within the USSR on a one-for-one basis. The missile is also to be found on the 30-mm gun-equipped BMP-2 as a roof installation in place of the 'Sagger' rail over the gun; a similar reload capacity is assumed. As far as it can be ascertained, the Soviets have not yet exported or used the missile in combat. Further applications of the 'Spandrel' are expected over the next year or so.

Specification

AT-5 'Spandrel'
Type: anti-tank missile
Dimensions: length 1.30 m (4 ft 3.2 in); diameter 15.5 cm (6.1 in); span not known
Launch weight: 12 kg (26.45 lb)
Propulsion: solid-propellant rocket
Performance: range 100-4000 m (110-4,375 yards)
Warhead: hollow-charge HE
Armour penetration: 750 mm (29.53 in) or more



A close-up of the BRDM-2's quintuple launcher arrangement for the AT-5. The 'Spandrel' is very similar to Euromissile's HOT in operation, and may be based on stolen technology.

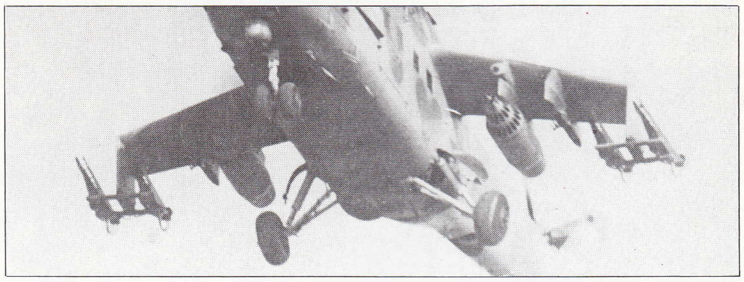
USSR

AT-6 'Spiral'

The tube-launched **AT-6 'Spiral'** is believed to be the first third-generation Soviet ATGW. At present it is only deployed on the Mil Mi-24 'Hind-E' assault helicopter (four rounds) but its presence on the new Mi-28 'Havoc' attack helicopter as its standard ATGW payload is expected soon. Much conjecture has arisen over its guidance system, laser homing with a fire-and-forget capability being the most favoured suggestion. Recently, however, informed sources in the USA have indicated that the weapon has a much-improved radio command guidance unit with considerably enhanced ECCM capability than its predecessor, the AT-2 'Swatter'. This would explain the apparent absence of a laser designator on the 'Hind-E'. No country other than the Soviet Union has fielded the AT-6, which indicates the importance of this missile in the Soviets' anti-armour force.

Specification

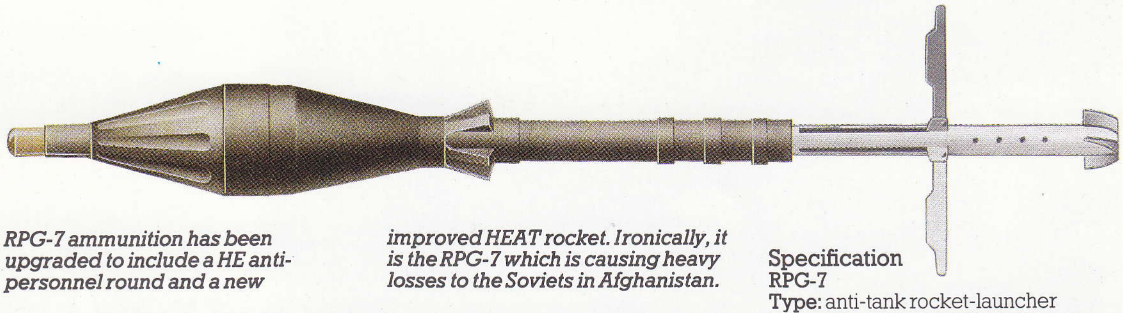
AT-6 'Spiral'
Type: anti-tank missile
Dimensions: length about 1.8 m (5 ft 10.86 in); diameter about 14.0 cm (5.5 in); span not known
Launch weight: 32 kg (70.55 lb)
Propulsion: dual-thrust solid-propellant rocket
Performance: range 100-7000 m (110-7,655 yards)
Warhead: 8-kg (17.6-lb) hollow-charge HE
Armour penetration: 800 mm (31.5 in) or more



A Mil Mi-24 'Hind' displays its empty AT-6 'Spiral' launch rails. No pictures have yet been released of the actual weapon.

USSR

RPG-7 family



RPG-7 ammunition has been upgraded to include a HE anti-personnel round and a new improved HEAT rocket. Ironically, it is the RPG-7 which is causing heavy losses to the Soviets in Afghanistan.

The **RPG-7V** is the standard man-portable short-range anti-tank weapon of the Warsaw Pact and its allies. It is similar to the earlier RPG-2 in having a calibre of 40 mm (1.57 in), but its anti-tank rocket diameter is 85 mm (3.35 in) instead of 82 mm (3.23 in). The firer screws the cylinder containing the propellant into the warhead and then inserts the complete round into the muzzle of the launcher. The warhead nosecap is then removed and the safety pin extracted. A pull on the launcher's trigger then fires the round, which is reasonably accurate when there is no cross wind; if there is such a wind, the round becomes very erratic. The length of the launcher and noise are also significant operational problems. In 1968 a folding version of the RPG-7 was seen, this subsequently being designated the **RPG-7D**, which is intended specifically for use by the airborne troops. The standard projectile is the 2.25-kg (4.96-lb) PGF-7 anti-tank round, which was supplemented in the late 1970s by the OG-7 anti-personnel fragmentation round and by the ballistically improved and penetration-superior PG-7M anti-tank round. A more modern rocket-launcher, tentatively identified as the **RPG-16**, has also been seen in service with the Soviet army in Europe and Afghanistan. This is believed to rectify most of the problems found with the RPG-7. The RPG series has seen widespread combat service throughout the world with both regular and irregular troops, and has turned up in Northern Ireland in the hands of IRA terrorists.

Specification

RPG-7
Type: anti-tank rocket-launcher
Dimensions: length 0.99 m (3 ft 2.98 in); calibre 4.0 cm (1.57 in)
Weight: 7 kg (15.43 lb)
Performance: range 300 m (330 yards) against a moving target and 500 m (545 yards) against a stationary target
Ammunition: see text
Armour penetration: PG-7 round 320 mm (12.6 in) and PG-7M round 400 mm (15.75 in) or more

Armed Forces of the World

US Air Force

Part 5

The third major US-based element of the USAF is Military Airlift Command (MAC) with headquarters at Scott AFB, Illinois. This, too, has recently undergone its fair share of reorganization, activating a third numbered air force and gaining several units from TAC. As its title implies, MAC is essentially concerned with airlift and, accordingly, it operates a large fleet of cargo-type aircraft, foremost amongst which must surely be the Lockhed C-5 Galaxy, this massive freighter and troop transport being ably supported by substantial numbers of the Lockheed C-141B StarLifter and the Lockheed C-130 Hercules.

Other areas of MAC endeavour include aeromedical airlift, a small fleet of McDonnell Douglas C-9A Nightingales used in conjunction with regular airlift aircraft to ensure that no US serviceman is more than a few hours from top-quality medical care. This command also performs a valuable humanitarian duty by means of the Aerospace Rescue and Recovery Service (ARRS), which operates helicopters and fixed-wing aircraft on such diverse tasks as local base rescue, combat search and rescue, and weather reconnaissance. MAC also has control of about 130 Rockwell CT-39 Sabreliners which perform routine liaison and communications functions throughout the USA and in Europe. Transport of VIPs is yet another task fulfilled by MAC, from Andrews AFB, Maryland, which lies conveniently close to the seat of government in Washington; it is this unit which operates 'Air Force One' for the President. Numbered amongst the fleet of aircraft and helicopter types operated by the 89th MAW which undertakes this duty are the Bell UH-1N Iroquois, Sikorsky CH-3E, McDonnell Douglas VC-9A, Lockheed VC-140B JetStar, Beech VC-6A, Grumman C-20A Gulfstream III, and the Boeing VC-137B/Cs of the Presidential Flight.

Finally, MAC also now controls several units engaged in highly specialized combat-type operations from bases in the USA, the Far East, the Panama Canal Zone and Europe, all fairly recent additions.

As far as airlift operations are concerned, these are the principal responsibility of the 21st Air Force at McGuire AFB, New Jersey, and the 22nd Air Force at Travis AFB, California, serving the eastern and western hemispheres respectively, and both of these organizations feature examples of the three principal cargo aircraft types in their line-up, permitting them to perform all aspects of the airlift mission. Units of the 21st Air Force located on the eastern seaboard of the USA comprise the 436th MAW with the C-5A at Dover AFB, Delaware; the 437th MAW with C-141Bs at Charleston AFB, South Carolina; the 438th MAW with C-141Bs at McGuire AFB, New Jersey; the 317th TAW with C-130Es at Pope AFB, North Carolina. Moving overseas, a subordinate element within the 21st Air Force, known as the 322nd Airlift Division administers MAC activities within Europe from Rhein-Main, controlling rotational C-130s at Mildenhall via the 313th TAG and permanently-based C-130Es at Rhein-Main with the 435th TAW. Other 435th TAW components include a handful of C-9As for aeromedical services within Europe, plus a small number of VIP and communications aircraft at Ramstein, these including examples of the CT-39A, VC-140B, Beech C-12A and C-135B.

A slightly larger command, the 22nd Air Force is similarly equipped, with the 60th MAW operating C-5As and C-141Bs from Travis AFB, California; the 62nd MAW C-141Bs and C-130Es from McChord AFB, Washington; the 63rd MAW C-141Bs from Norton AFB, California; the 314th TAW C-130s (including a training squadron) from Little Rock AFB, Arkansas; the 463rd TAW C-130Hs from Dyess AFB, Texas; and the 616th MAG C-130Es from Elmendorf AFB, Alaska. Also forming part of the 22nd Air Force is MAC's principal jet transport training unit, this being the 443rd MAW at Altus AFB, Oklahoma, with examples of both the C-5A and C-141B, whilst overseas assets in the Far East are grouped together under the control of the 834th Airlift Division at Hickam AFB, Hawaii, and include single squadrons of aeromedical C-9As and airlift C-130Es with the 376th TAW at Clark AB in the Philippines and a further squadron of C-130Es with the 316th TAG at Yokota AB, Japan.

MAC's newest command echelon, the 23rd Air Force at Scott AFB, Illinois, was established recently and this now looks after the ARRSs and the small number of special operations units, the former having previously reported direct to MAC head quarters at the same base. ARRS assets have also

A Boeing VC-137C of the Presidential Flight, a component part of the 89th MAW based at Andrews AFB, Maryland. This aircraft is used to fly the President and other high-ranking officials to various parts of the world. When the President is aboard, its callsign becomes 'Air Force One'.

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UNITED STATES OF AMERICA

contracted in recent years with regard to the chain of command, a couple of squadrons having been eliminated although the number of active elements has remained fairly constant. Extensive use is made of detachments, most operating variants of the highly versatile Bell UH-1 Iroquois although a few have the larger Sikorsky HH-3E. The bulk of the rescue forces are grouped together within the 39th Aerospace Rescue and Recovery Wing at Eglin AFB, Florida, controlling four squadrons, namely the 37th ARRS at F.E. Warren AFB, Wyoming; the 40th ARRS at Hill AFB, Utah; the 55th ARRS also at Eglin; and the 67th ARRS at RAF Woodbridge in Suffolk. Space does not permit a detailed listing of the various detachments but it should be noted that the 37th and 40th ARRSs operate only Bell Hueys whilst the other two squadrons number the Lockheed HC-130 Hercules, Sikorsky HH-53C/H, Bell UH-1 and Sikorsky HH-3E amongst their inventory, some examples of the Sikorsky UH-60A Black Hawk having recently been assigned to the 55th ARRS for training purposes in anticipation of the acquisition of a considerable number of HH-60Ds in the fairly near future.

Without inflight-refuelling, the Lockheed C-5A Galaxy has a disappointing range, but its load-carrying capacity and ability to land on front-line airstrips make it an extremely valuable tool. Remaining Galaxies are now receiving new wings to extend their service lives.

The Lockheed C-141 StarLifter forms the backbone of Military Airlift Command's strategic transport fleet. All USAF StarLifters have now been rebuilt as C-141Bs, with greater cargo capacity and inflight-refuelling gear. This aircraft is a C-141A before modification.

U.S. AIR FORCE